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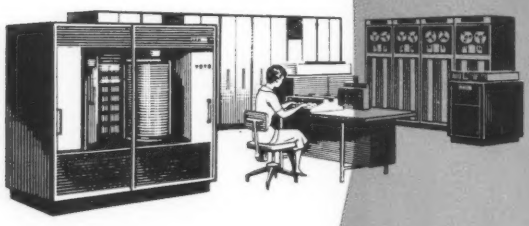

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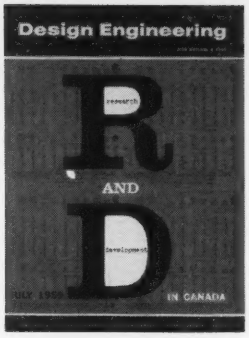

Design Engineering

Vol. 5 JULY 1959 No. 7

This month's cover

When we tried to sum up R and D in Canada for the cover theme, we ran into snags. What symbolized this work in one field, drew blank stares in another (we tested pencil roughs on various engineers). The final choice, as carried out by **Leslie A. Smart,** one of Canada's leading typographic designers, typifies the bold strength of the subject and suggests the maze of detail work that lies behind every R and D project undertaken.

Design Engineering

MEMBER

CCAB

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CONTENTS

Features

The reason for this issue 5, 6

The origin of research in Canada 47

How Canada compares with U. S. and U. K. in research 50

The provincial research councils 53

An aggressive R and D policy pays off 57

Research in the Canadian universities 58

Research in the nickel industry 66

Experience proves the value of R and D 68

Here's help for the budding engineer 70

Keeping track of engineering personnel in Canada 74

Industrial roundup by DE's editors 77

What Design Engineers say about R and D 79

The national press comments on R and D 80

Departments

Authors 3

Briefs 82, 83

Editorial 94

Keeping informed 81

People in the news 84, 89

Reader service card 85, 86

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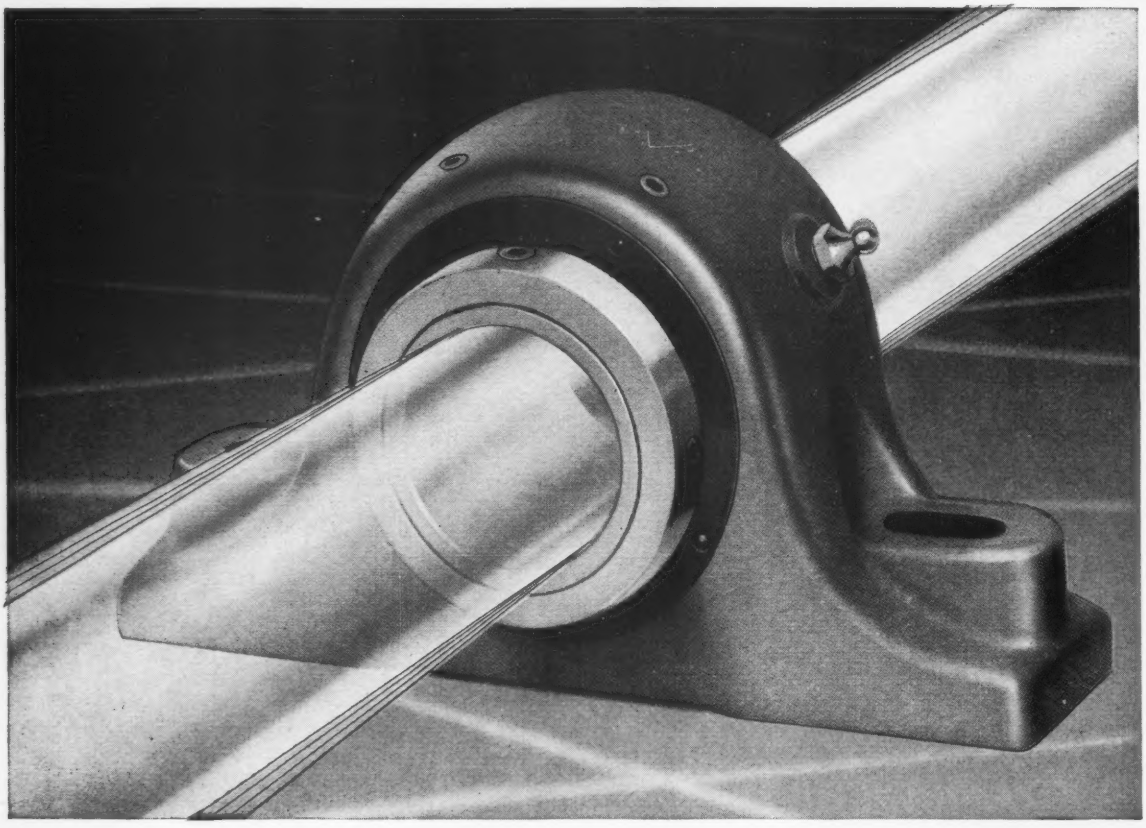

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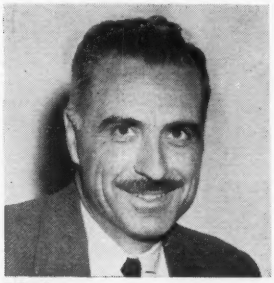


Mackay

Dr. W. B. F. Mackay joined Atlas Steels in February 1956 (he is research development engineer), after serving as Asst. Professor of Metallurgical Engineering at the University of Minnesota. Born in Winnipeg, he got his B.Sc. (EE) from the University of Manitoba and his B.Met.E., M.S., and Ph.D. degrees in physical metallurgy from Minnesota. Imparting a military ring to this metallic past, we can tell you that Mackay is also an RMC graduate — was a wing commander during World War II.

Lay

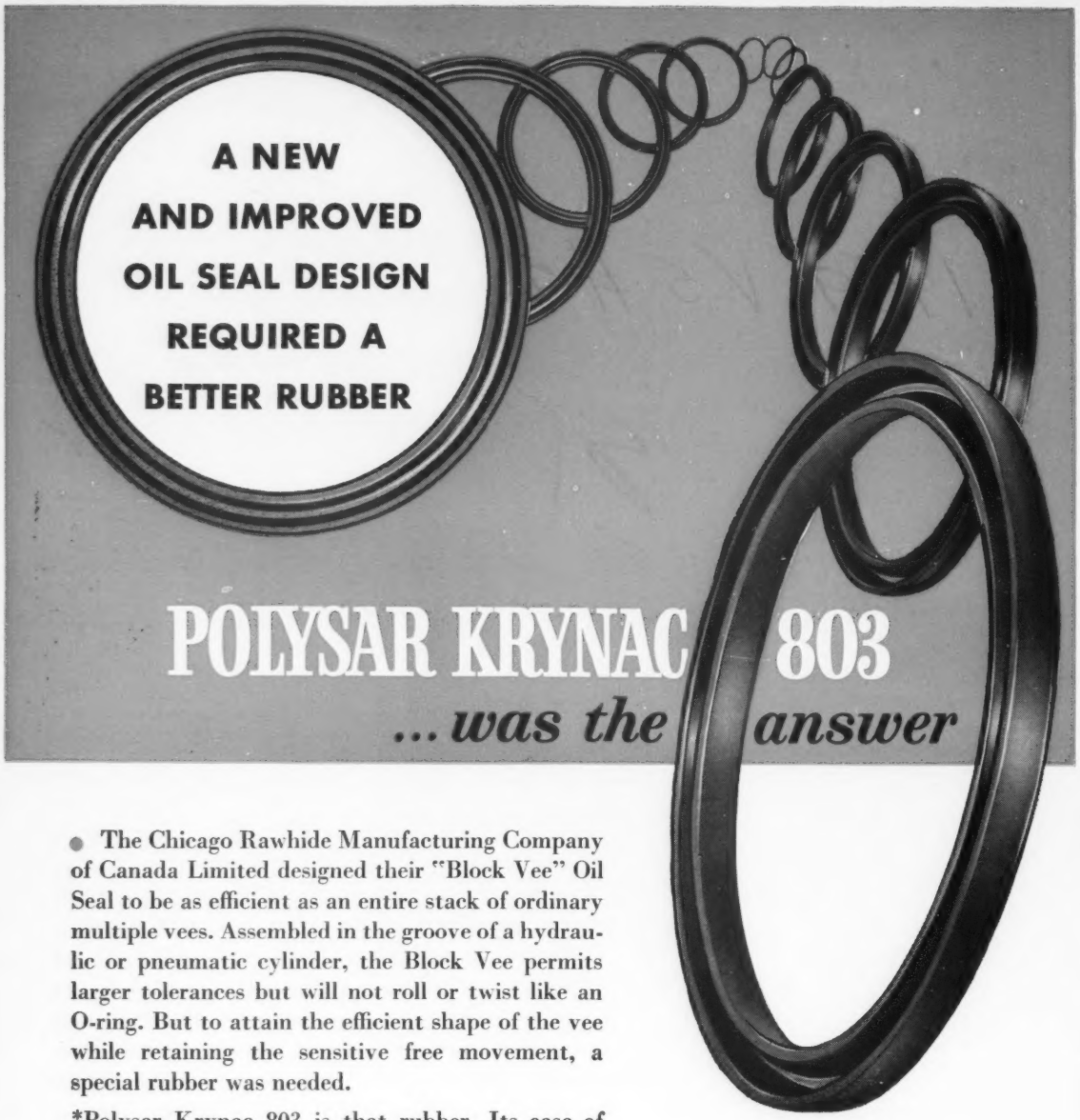
R. A. (Bob) Lay is a man pretty close to research in Canada — he is a public relations officer with the National Research Council in Ottawa. Born within sight of the Peace Tower, he is a graduate (B.A.) of Carleton University. Lay tells us that he is still without wives or children, and so has time to pursue the arts, swim, read and promote rampant individualism like Maria Callas. (We have made a note to check Lay's status in a year's time—then ask him for a list of his hobbies.)

One of DE's July contributors had his wings clipped not long ago. We think the family did the clipping—and they grounded our poor man from his hobby of gliding. He now has to be content with golf, gardening and stereo. **R. M. (Bob) Cuddy** is a mechanical engineering graduate of Queen's University and has had a varied industrial experience supervising plant engineering, production control and manufacturing. He is presently chief engineer of Beatty Bros, and has a very real interest in R and D. Cuddy is a former RCAF pilot.

Cuddy

Since 1944, **J. P. Francis** has held a number of positions with the Canadian Department of Labour. He is now Chief of the Manpower Resources Division in the Economics and Resources Branch. This brings him very close to the training and utilization of Canada's engineering and scientific needs. Francis is a B.Comm. graduate of the University of Toronto. He writes and lectures on manpower resources and recently returned from Paris, where he attended conferences devoted to this and related subjects.

Francis



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Design Engineering

RESEARCH AND DEVELOPMENT IN CANADA

Exclusive DE Issue

The idea for this issue had its origin in uncertainty. Uncertainty because of the loose definition of "Research and Development." In reading the national press, business reports and technical papers, we felt the term had a different interpretation in each instance. / If we were confused, was it not possible that our readers were too? Also, we kept reading Everest-high figures about R and D in the United States and the United Kingdom. In comparison, the Canadian figures (when quoted) seemed paltry. What to do then but find out about R and D for ourselves – and present the story to you. / This is what we have done. We made no alarming discoveries – though we discovered some sober truths. One is that Canadian expenditure on research by industry must expand if Canadian industry is to grow. / We also learned about two

R:D

factors that have affected the development of industrial research in Canada. That primary industries, like agriculture and mining, were of necessity developed first and so had a headstart on secondary industries. This, obviously, is the normal course of events in a country as it becomes industrialized. Also, because Canada rubs shoulders with the U. S. and because of the financial ties with the U. S., and the U. K., many Canadian plants are branch plants – and research is normally done by the parent (or affiliate) organization outside Canada. (An example is Bell Telephone, a company doing little or no basic research in Canada, but paying fixed dues to share in its affiliate company's $90 million annual research budget). A result of this program is easy to see. Generally, Canadian industry has been largely dependent on research and development being carried out in the U. S. and the U. K., and government research agencies. Unlike the U. S. and the U. K., Canada has never gone through a period where there was a large body of industrial research in industry and a small amount in government institutions. / In DE's own survey made of cross-sections of various major industries, it was encouraging to find that many companies pursue a self-imposed R and D program. Several frankly said that it was the only logical way to keep ahead of both domestic and foreign competition. / Altogether, the picture is not as discouraging as we had been led to believe. A great boost to R and D in Canada has been the government's expanded support for university research. As will be seen elsewhere in this issue, Canadian industry too, is financing all kinds of student-aid scholarships – with heavy emphasis on post-graduate research. This long term investment will not be felt for several years. / While expenditure on research by industry is low, there has been a steady expansion since the war. This must continue and be promoted by industry itself, if Canadian industry is to develop. ★

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These corrosion-proof valves have only one internal moving part and a completely protected solenoid coil. The coil is fully sealed from air, oil, gas and water . . . and will not overheat on continuous duty. Coils for continuous or intermittent duty, a-c or d-c, are interchangeable.

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ORIFICES	1/16" THROUGH 3/16"	1/8" AND 3/16"
VOLTAGE	MOST A-C AND D-C	MOST A-C AND D-C
DUTY	CONTINUOUS	CONTINUOUS
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Everything Under Control

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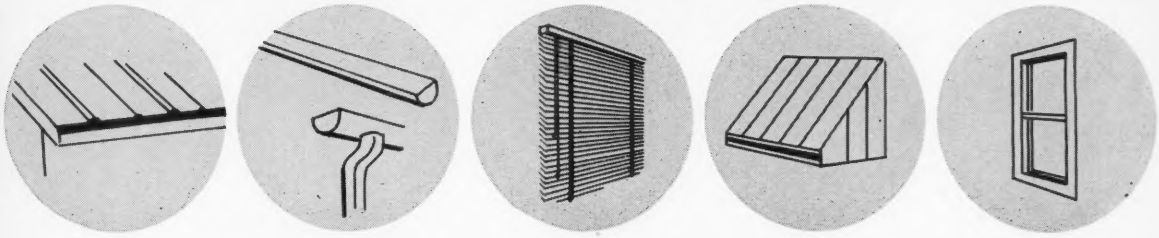
BONDERIZED ALUMINUM

makes your painted products look better longer



Most famous of all surface treatments for metals—BONDERITE—makes painted aluminum look better longer.

Bonderite on aluminum means fine appearance longer, because it controls corrosion and anchors the paint.

Bonderized and painted aluminum is produced on automated strip lines in which the metal is cleaned, Bonderized and painted, then re-coiled ready for use.

Stamped or roll-formed products are made from pre-painted, Bonderized aluminum coil without loss of paint adhesion, even from the most severe deformation. Here's production efficiency and economy at its best—better products at less cost.

Many Applications of Bonderite for Aluminum

There's more than one type of Bonderite for use on aluminum. In wide use is Bonderite as a base for paint, which adds durability and long life to paint finishes on so many aluminum products.

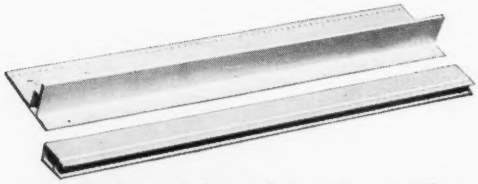
Another Bonderite produces an attractive green coating, used on many architectural products without further finish.

Protection without changing the characteristic color of the metal is provided by another Bonderite.

There is also a Bonderite, formulated for mixed production, which coats aluminum, steel and zinc.

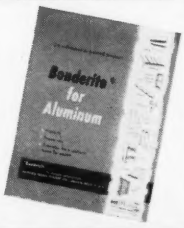
Bonderite for aluminum meets and exceeds the requirements of Government Specification MIL-C-5541.

Well over two hundred plants—large, medium-sized and small—use these great Parker products on their aluminum production. Better investigate for *your* plant, today!



Aluminum window and screen frame sections Bonderized, painted and formed after painting. No breaks in finish anywhere! (Courtesy, Security Co., Detroit, Mich.)

SEND FOR ILLUSTRATED BULLETIN!—*Free bulletin, with more complete information and details, mailed immediately upon request. Ask for Bulletin A6790, "Bonderite for Aluminum."*



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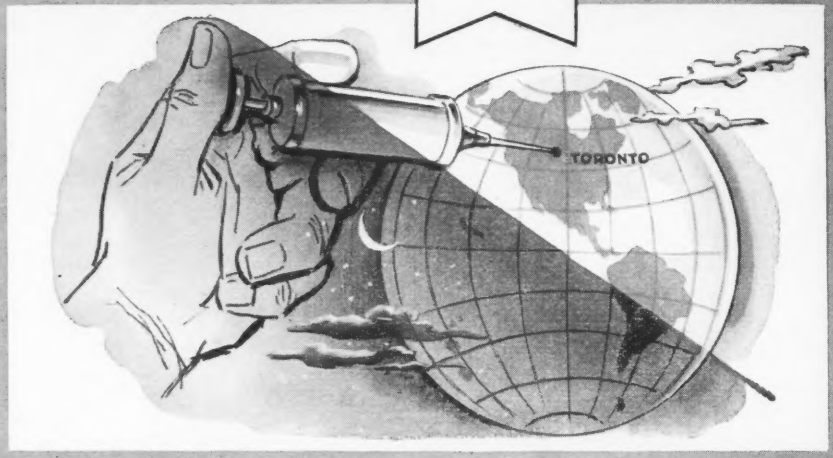

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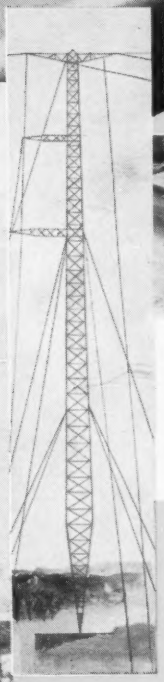

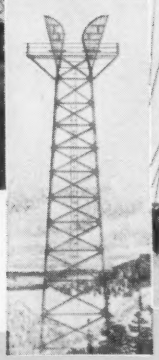

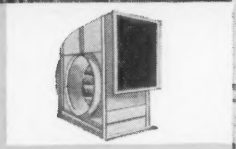

Equal Leg Angles
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$2''$ x $1\frac{1}{2}''$ up to $6''$ x $4''$ in gauges .10″ to .25″

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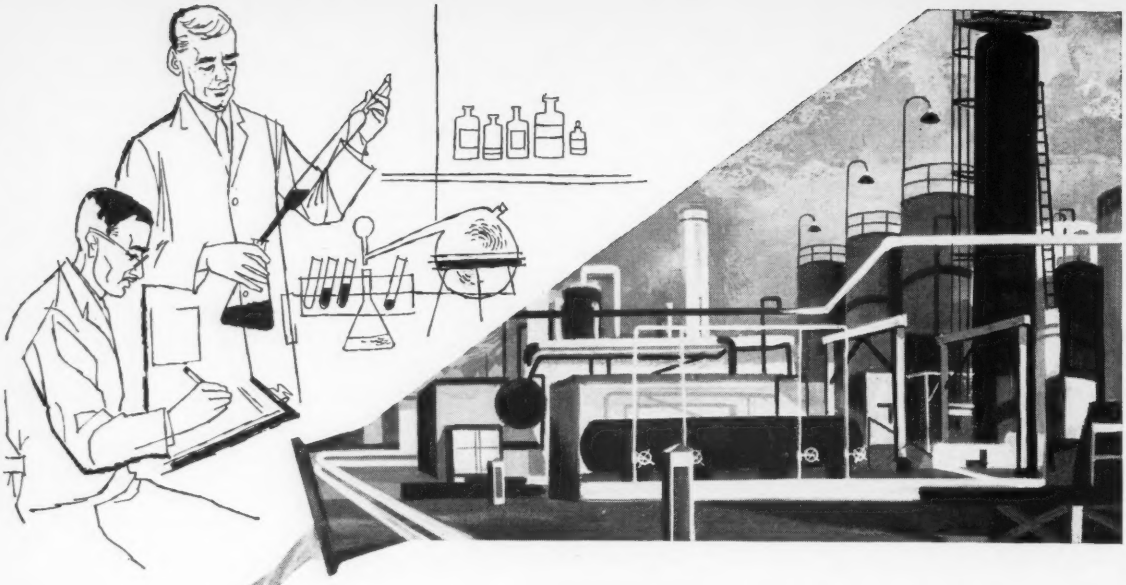

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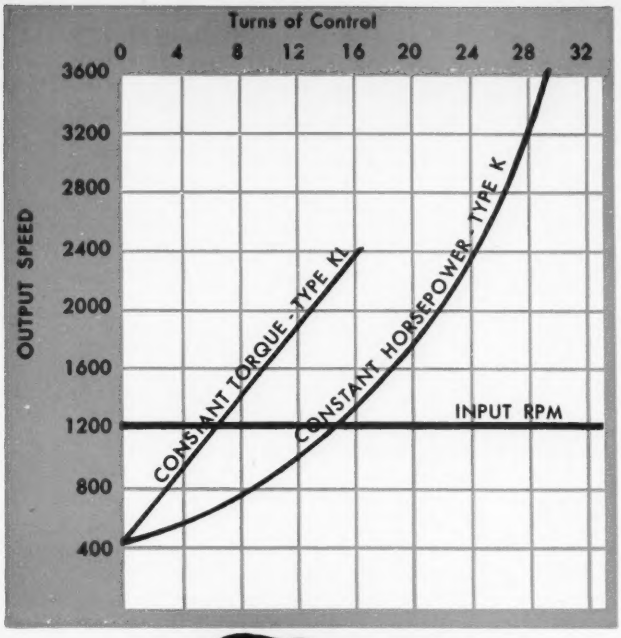
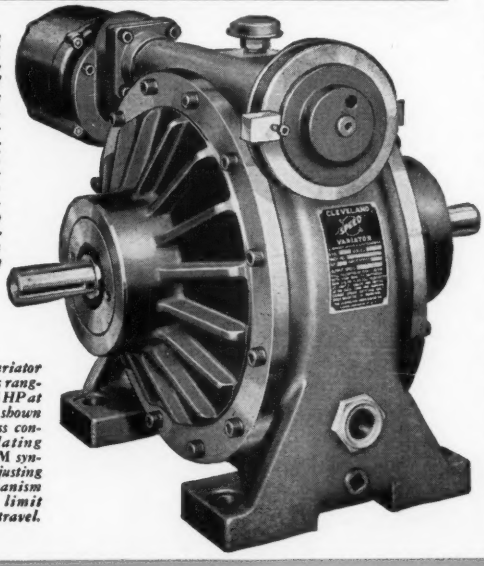


Typical speed regulation curves for the Types K and KL Variators. Type KL offers a linear speed regulating pattern, often an advantage in automatic control applications. Output speed regulation of the Type K Variator follows a geometric progression pattern. Starting at the minimum output speed, each turn of the speed regulating wheel produces a fixed percentage increase in output shaft speed.



The Cleveland Speed Variator is available in 18 models ranging from fractional to 16 HP at 1750 input RPM. Unit shown at right, used in process control, has speed regulating worm driven by 75 RPM synchronous motor, with adjusting shaft indicating mechanism modified to actuate limit switches to prevent overtravel.

CLEVELAND SPEED VARIATOR

Accurately Provides Dependable, Infinitely Variable Speed Control

ANNOUNCED late in 1954, the new Cleveland Speed Variator met instant, enthusiastic acceptance. Engineers and designers of industrial equipment already have put thousands of units into use on such varied equipment as cigarette making machines, textile machinery, metalworking machinery, pharmaceutical equipment, transfer tables, conveyors and experimental and testing equipment of many types.

Infinitely variable, the Cleveland Speed Variator gives stepless speed over a full 9:1 range—from ⅓ to 3 times input speed. Output speed can be adjusted by either a hand wheel on the Variator or by manual or automatic remote control.

The Cleveland Speed Variator offers these major advantages:

1. An extremely compact unit with input and output shafts in line and rotating in the same direction.

2. Almost any input speed up to 1800 RPM can be used—either clockwise or counterclockwise rotation.

3. Rated for constant horsepower output over a 9:1 or 6:1 range; or for constant output torque over a 6:1 range.

4. Speeds infinitely variable over entire range of adjustment.

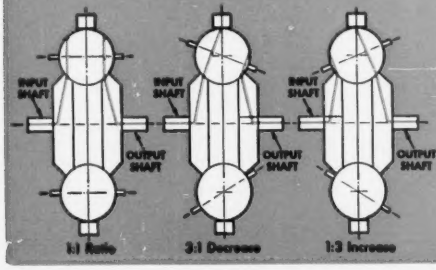
5. No slippage—positive torque response mechanism adjusts in direct proportion to the loads encountered.

6. Long life and minimum maintenance due to absence of belts or complicated linkages.

7. Ample bearing support for overhung pulleys on both input and output shafts.

Write for Bulletin K-200 for detailed description with photographs, sectional drawings, rating tables and specifications.

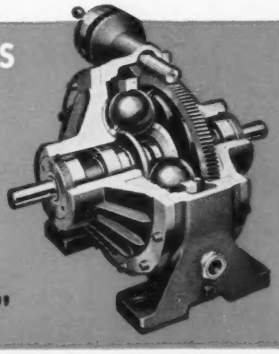
HOW THE CLEVELAND SPEED VARIATOR WORKS



Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts.

Relative speeds of the shafts are adjusted by changing the positioning of axles on which the balls rotate (diagram, right, shows cutaway Variator with hand regulating wheel).

"It's the Drive That's on the Ball."



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provide a unique combination of useful engineering properties

Ni-Resist ductile austenitic irons are a new group of versatile high-alloy cast irons recently developed by Inco. Containing 18 to 36% Nickel, they have the same qualities of corrosion and heat resistance as has Ni-Resist flake graphite iron, in addition to high levels of strength and ductility. Each of the several types of Ni-Resist ductile irons combines a useful array of engineering properties.

Strength—tensile strengths of 55,000 to 80,000 psi; yield strengths of 30,000 to 44,000 psi.

Toughness—nickel alloy matrix develops full ductility and strength . . . gives elongations of 4 to 40%, together with good impact resistance.

Corrosion resistance — Ni-Resist ductile irons safely handle hundreds of corrosives. Their performance is far superior to both cast iron and steel . . . so maintenance costs are reduced.

High temperature properties—Ni-Resist ductile irons form a tightly adhering scale at elevated temperatures, greatly reducing further oxidation. They have excellent thermal shock resistance . . . resist heat effects up to 1400°F and higher. From 1100° to 1300°F, Type D-2 has stress rupture properties equal to those of stainless steel.

Wear resistance—Ni-Resist ductile irons have a work-hardening austenitic matrix. Graphite particles provide dry lubrication. Both these properties work together to resist wear and galling over a wide temperature range.

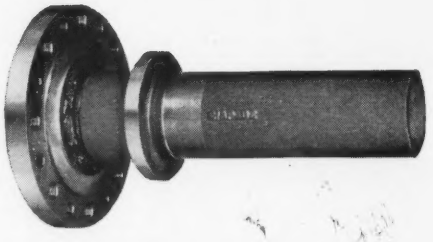
Erosion resistance—Ni-Resist ductile irons work well in high velocity liquids, wet steam, brine or salt slurries. This means long service life for pump parts.

Controlled expansion—You can match Ni-Resist ductile irons with steels, cast irons, Nickel, Monel* alloy . . . with aluminum, copper, bronze and stainless steel. This is possible because Ni-Resist ductile irons have thermal expansivities from about 2.5 to 10.4 millionths of an inch per inch per degree F.

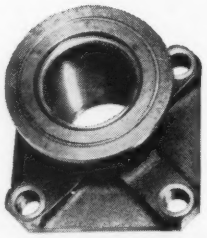
Non-magnetic properties—Ni-Resist ductile irons Types D-2 and D-2C are non-magnetic. They are therefore useful where non-magnetic properties are required in electrical or other apparatus.

Machinability—Because Ni-Resist ductile irons have graphite in their structure they machine readily.

Fluidity in casting—Intricate designs can be made because Ni-Resist ductile irons have good castability.



Application: Overflow nozzle for Bauer pulp stock cleaner. *Requirements:* Corrosion and wear resistance with high strength. *Material:* Ni-Resist Ductile Iron Type D-2. *Producer:* Canada Iron Foundries Limited.



Application: Bushing at base of insulators on the dome of an electrical circuit breaker. *Requirements:* Non-magnetic, corrosion resistant. *Material:* Ni-Resist Ductile Iron, Type D2C. *Producer:* Canada Iron Foundries Limited.

Suppliers of Ni-Resist Ductile Iron:

Canada Iron Foundries Limited . . . . . Hamilton, Ont.
Montreal, P.Q.
Letson & Burpee Limited . . . . . Vancouver, B.C.

For complete information on this versatile new family of metals, mail the coupon below for your free 28-page booklet, "Engineering Properties of Ni-Resist Ductile Irons."

THE INTERNATIONAL NICKEL COMPANY OF CANADA, LIMITED
55 YONGE STREET, TORONTO

INCO TRADE MARK

*Trademark

The International Nickel Company of Canada, Limited,
55 Yonge Street, Toronto 1, Ontario.

Dear Sirs: Please send me the booklet, "Engineering Properties of Ni-Resist Ductile Irons."

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longer life
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Canada Iron produced these Crusher Rings in Ni-Hard alloy iron for a leading Canadian chemicals producer. The bore and keyway were cast to size in this unmachinable material with *sufficient accuracy* to permit assembly on a carrier drum within prescribed tolerances. The Ni-Hard Crusher Rings last *twice as long* as the chilled cast iron rings previously used.

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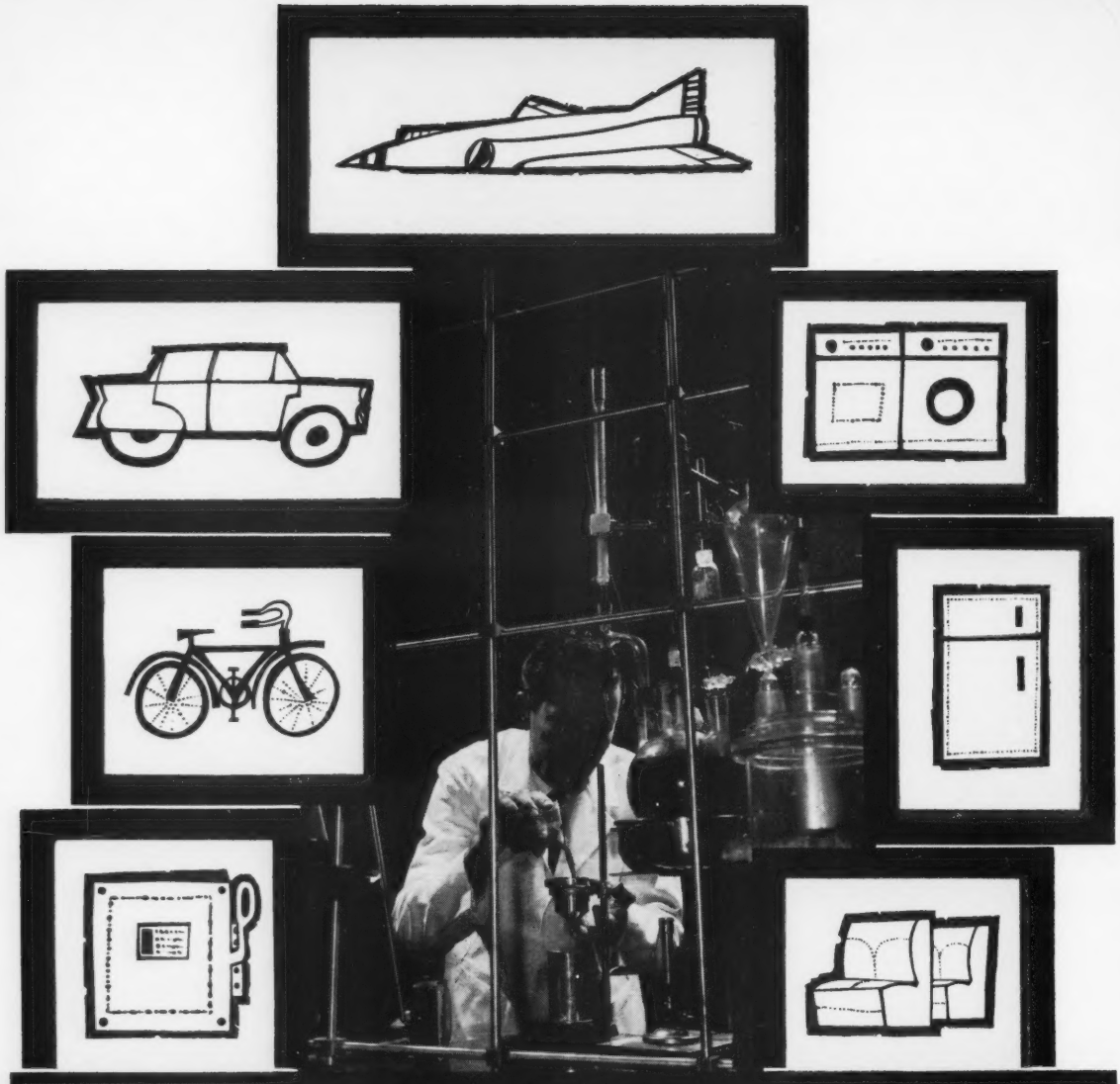

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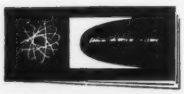
Every day, GLIDDEN is producing *improved finishes* for hundreds of different Canadian products.

Completely new finishes, developed by Glidden research experts, are adding to the value of products by cutting costs, increasing efficiency and "life".

Through truly creative research—test and retesting, conducting repeated experiments with new and better finishes—Glidden chemists are in a unique position to assist you. They are highly qualified and the GLIDDEN Laboratory provides them with the most modern research facilities.

The GLIDDEN Technical Service Department employs the same creative approach in helping to solve on-the-job problems. Our Technicians will come right into your plant if you wish. For further information please contact our service representative or write to us direct.



INFORMATION YOU'LL VALUE

This booklet outlines all Glidden Laboratory and Technical Services—and how you can profit by them. We will gladly send you a free copy . . . just write to:

THE GLIDDEN COMPANY LIMITED

Technical Service Department • 351 Wallace Ave., Toronto, Ont. • 133 Elmslie St., Ville La Salle, Montreal 32, P.Q.

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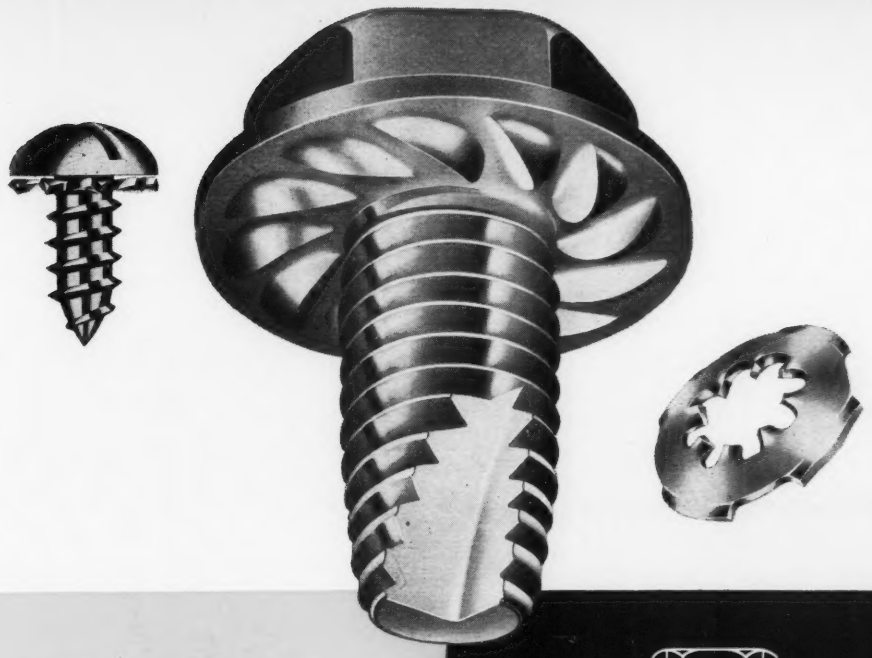
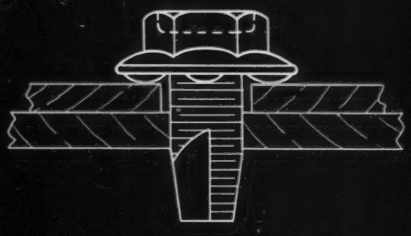


HOW TO SELECT COST-SAVING

fasteners for sheet metal

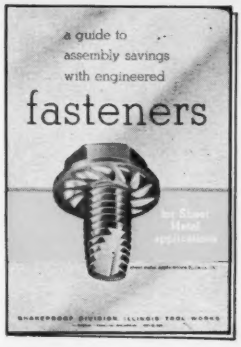


A TYPICAL EXAMPLE:
How to Avoid Stripping–

When high stripping torques are required, a Shakeproof NIBSCREW® should be used. "Nibs" under the head take up excessive driver torques and eliminate loose screws, re-work and repair.

You can realize important savings on your assembly line by specifying fasteners that eliminate operations, speed up production and assure highest quality. Engineered Fasteners by Shakeproof now overcome stripping, provide sealing, assure maximum locking and solve countless production problems encountered in mass assembly of products using sheet metal.

SEND FOR NEW SHAKEPROOF BULLETIN NO. 100! Illustrates twelve typical examples of cost saving fasteners for sheet metal applications. Describes important "check points" for fastener selection. Offers testing samples. Write for your copy today!



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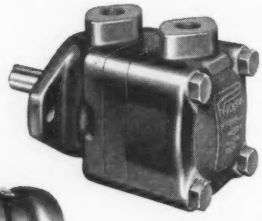
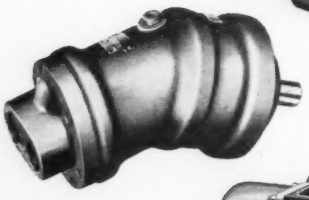
Dredge "Andrew B". Vickers Hydraulics have helped it "exceed all expectations of production."

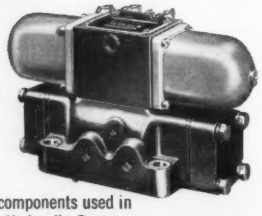
New Production Records Set by "Dredge of Tomorrow" With Help of a VICKERS® Hydraulic System



Vickers Vane Type Hydraulic Motor



Vickers Piston Type Hydraulic Pump



Vickers Solenoid Controlled Directional Valve

Above are some of the components used in the "Andrew B" Vickers Hydraulic System.

Built by Port Weller Dry Dock Limited, the "Andrew B" has been called the "Dredge of Tomorrow". Its owners, the Russell Construction Co. Ltd. report that it has set new production records for 24 hour service on the Welland Canal.

The spuds (used to secure the position of the dredge) are raised and lowered with Vickers hydraulics much faster than by any previous method. Warping winches for handling of dump scows alongside the dredge are also economically and positively powered by Vickers hydraulics.

Vickers-Sperry of Canada Ltd. offers you these advantages when specifying oil hydraulic equipment.

- Complete hydraulic system service—equipped to design, build, install, and service the entire system.
- Proven experience with marine hydraulic applications since 1903.
- Rugged, dependable equipment, many hydraulic units have been in use for 20 to 25 years, some without overhaul.

Have a Vickers-Sperry application engineer show you how Vickers complete hydraulic systems can efficiently solve your marine power or control problems or write for Bulletins 5300 and 5001 for further information.

8235

VICKERS-SPERRY of Canada Ltd.

Division of Vickers Incorporated

SPERRY RAND CORPORATION

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Dominion Rubber

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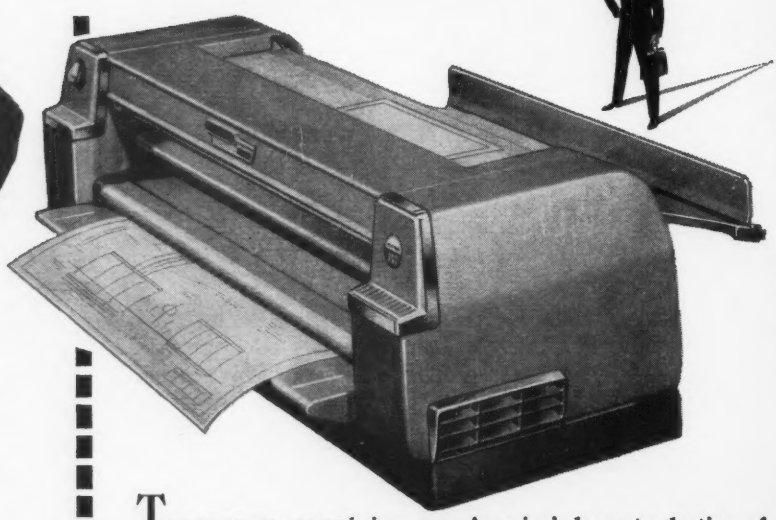
says *the* **BRUNING** *man*



THE BRUNING MAN brings you America's largest selection of reproduction equipment. For instance, the Copyflex "300", that sits on desk top or table, gives prints 30" wide by any length with uniform sharpness and clarity without venting or odour problems. With intermediates, you make design changes without reworking originals: you make composite prints, colour overlays, and sharp prints from weak originals.

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IN STEP WITH MAN'S PROGRESS

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the finest bearings in the world

As the scientific research of today becomes the industry of tomorrow SKF contributes in the bearing field world-wide engineering research and skill based upon over 50 years' experience in the manufacture of the world's finest bearings.

CANADIAN SKF COMPANY LIMITED

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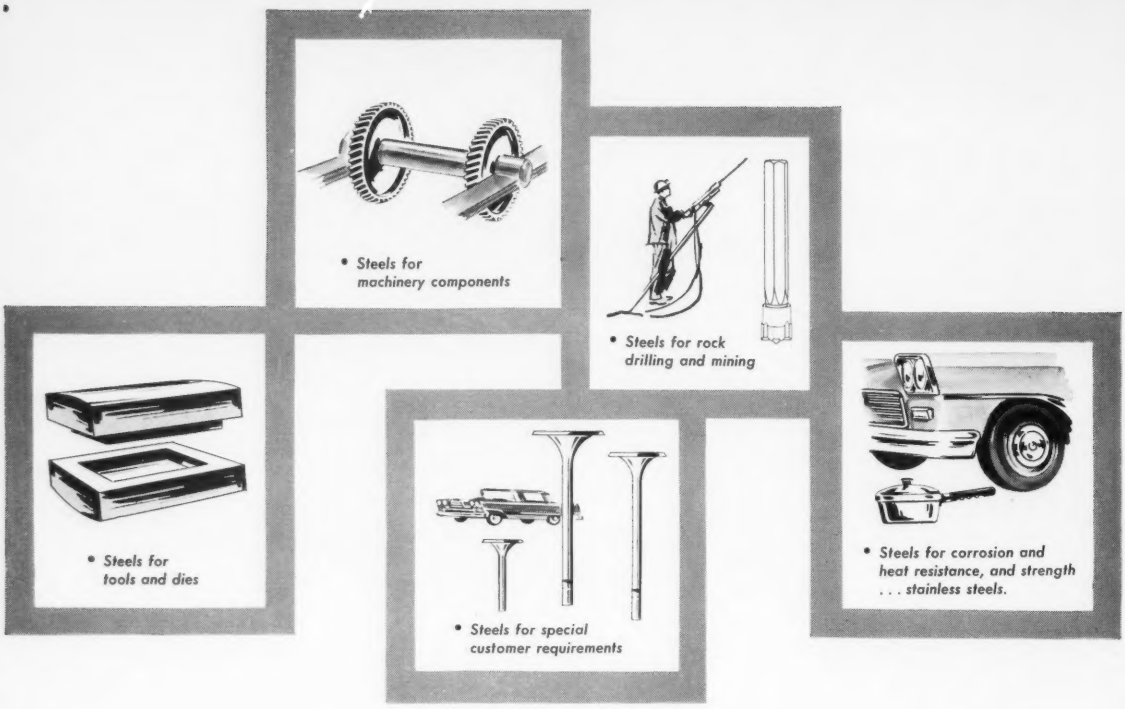
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• Steels for corrosion and heat resistance, and strength . . . stainless steels.

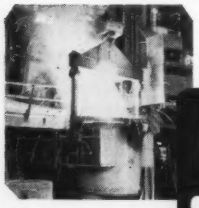
FOR ALL INDUSTRY
CANADA'S LARGEST SELECTION OF

SPECIALTY STEELS

Atlas offers a supermarket selection of specialty steels in 5 basic groups—High Speed and Tool Steels, Machinery Steels, Mining Drill Steels, Special Purpose Steels, and Stainless Steels. Over 200 Atlas specialty steel grades are produced to meet the broad requirements of industry. Many of these are tailored to individual requirements of size, shape and finish. Some are furnished to special analyses or with special physical properties. In all, Atlas specialty steels are made in over 16,000 sizes, shapes and finishes.

Despite this wide product range, delivery is quick and reliable from Atlas' six strategically located warehouses, which stock a combined total of 10 million pounds of specialty steels.

Atlas can supply exactly the right steel for *your* needs as well as the metallurgical and technical information to overcome any metal problems you may have. Contact your Atlas representative for full product details and obligation-free service.



Atlas specialty steels are produced in Welland, Ontario in electric arc furnaces which afford maximum quality control of both physical and metallurgical properties.

ATLAS STEELS

ATLAS STEELS LIMITED
WELLAND ONTARIO

Warehouses: Montreal, Toronto, Hamilton, Windsor, Winnipeg, Vancouver
Representatives: London, St. Catharines, Sudbury

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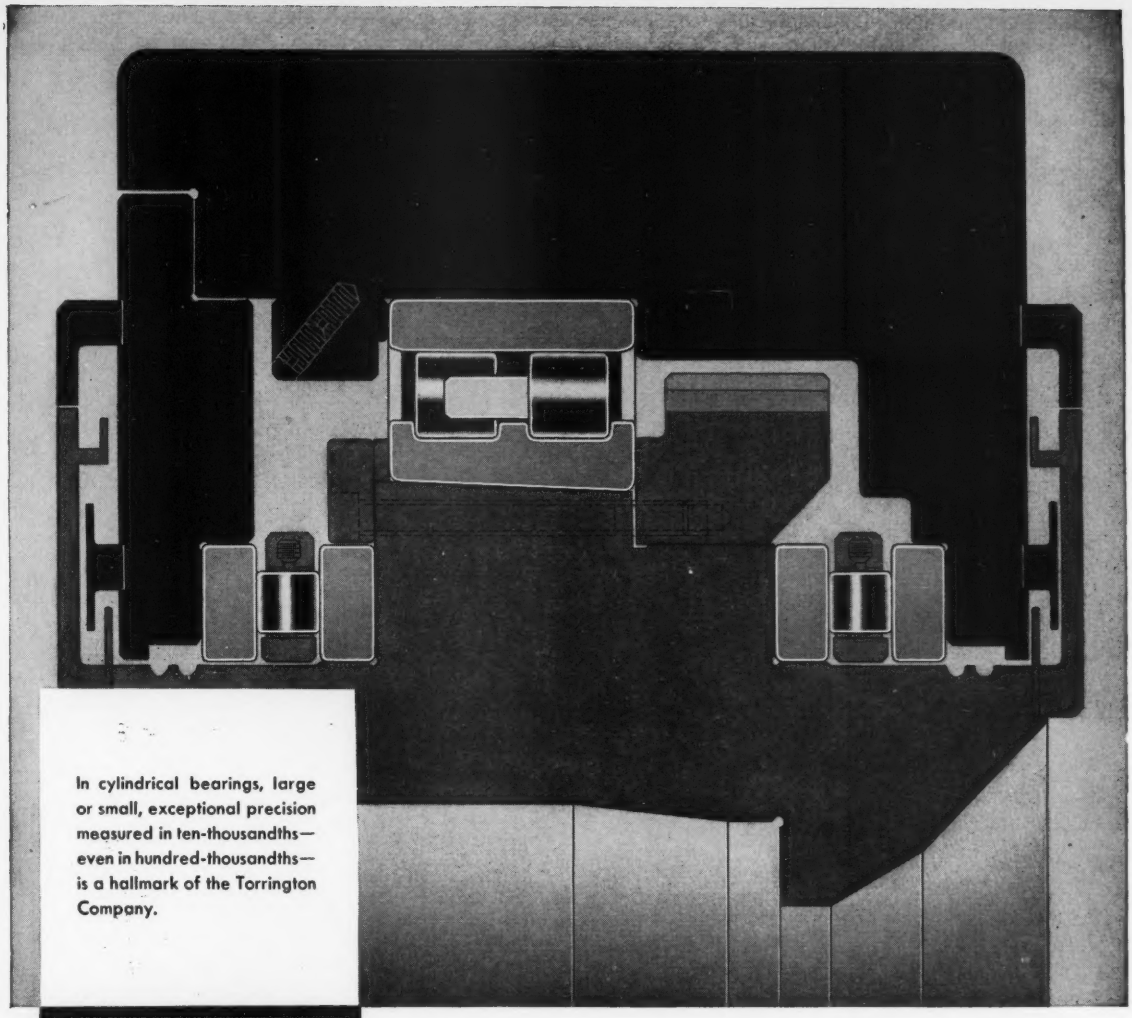
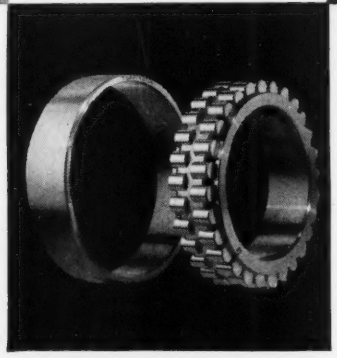


In cylindrical bearings, large or small, exceptional precision measured in ten-thousandths—even in hundred-thousandths—is a hallmark of the Torrington Company.



Turns true within three "tenths"!

To the engineer, that means these large Torrington Cylindrical Roller Bearings have a total radial runout of only .0003"—three ten-thousandths of an inch! To anyone, that means ultra-precision.

These are spindle bearings custom-built for Gisholt Machine Company's center drive lathe. The tapered bore, two-row radial roller bearing is 44.2500" OD, capacity 189,000 pounds at 100 rpm. Face runout is held to .0005". Each of two cylindrical thrust bearings used is 38.4700" OD, capacity 105,000 pounds at 100 rpm. Diameter of rollers in any one bearing is held within one-half "tenth"—.00005".

This close approach to perfection is made possible by specialized equipment and superior workmanship, which go into the manufacture of every Torrington Bearing, large or small. Of course, not every application requires such ultra-precision. But each bearing requirement is given the extra measure of care that makes Torrington quality a byword in industry. **The Torrington Company, Limited, 925 Millwood Road, Toronto 17, Ont.**

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There are a lot of sharp pencils in use these days — production costs *must* be kept in line to meet increasing competition. Speed Nuts are specially designed fasteners that save time and money on *every* assembly operation. There are 8,000 kinds now in use, and we will gladly design types to meet *your* special needs.

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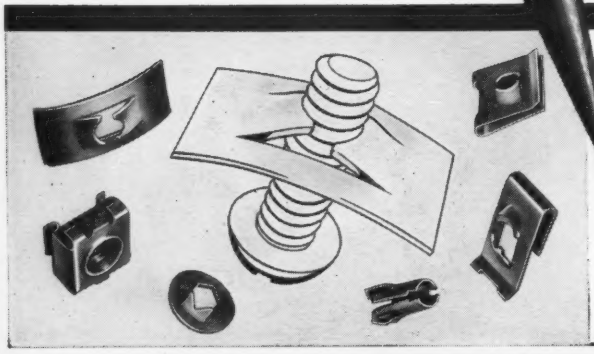
DOMINION FASTENERS

Speed Nuts®

Exclusive TINNERMAN Canadian Licencee



DOMINION FASTENERS LIMITED

a Geo. A. Tinnerman corporation

HAMILTON, ONTARIO. Sales Branches: Toronto, Montreal

Like most manufacturers, I want to get my production costs down. Please rush complete information on how Speed Nuts can help me.

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COMPANY_____

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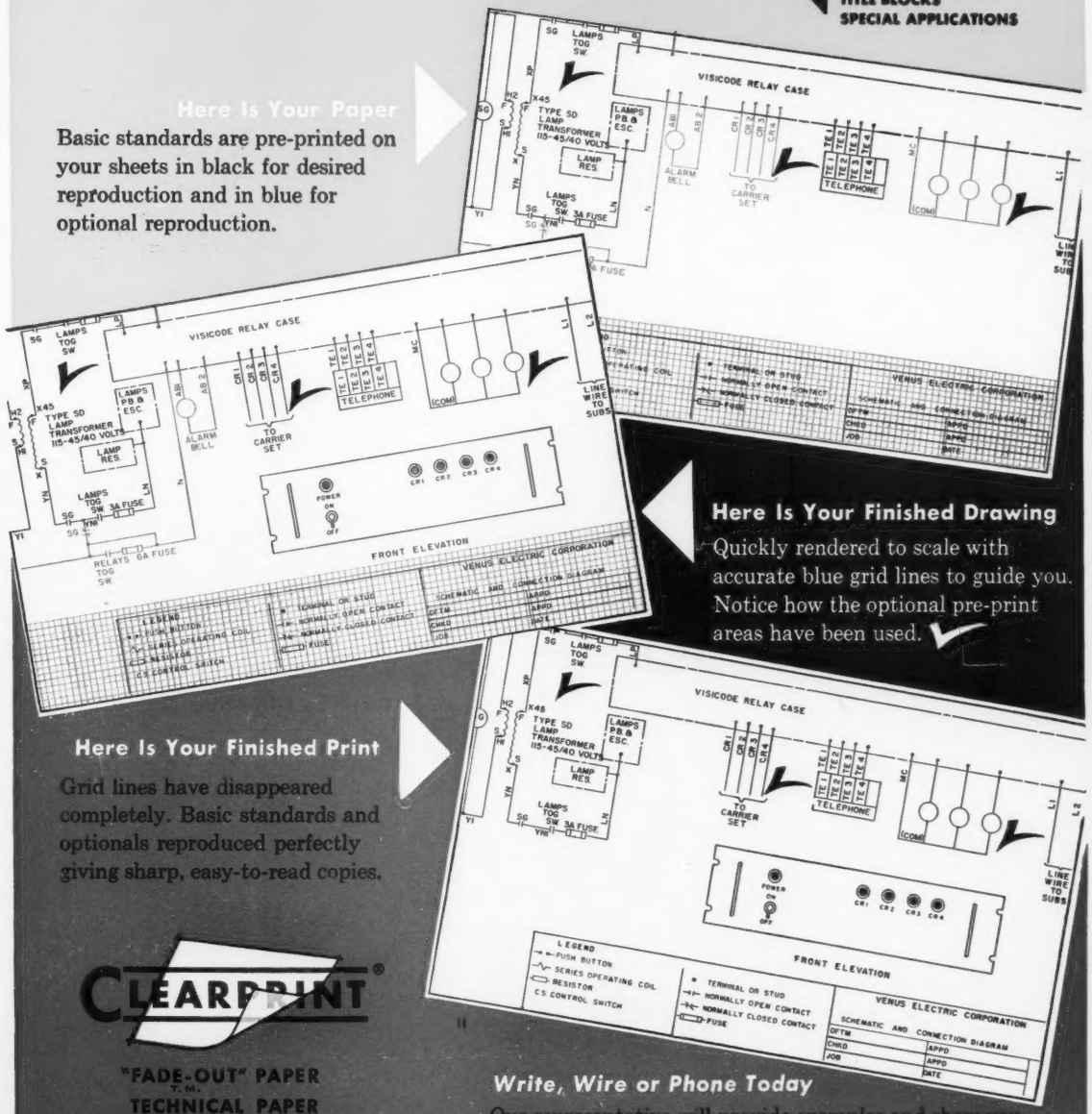
Here Is Your Paper

Basic standards are pre-printed on your sheets in black for desired reproduction and in blue for optional reproduction.



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Quickly rendered to scale with accurate blue grid lines to guide you. Notice how the optional pre-print areas have been used.

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Grid lines have disappeared completely. Basic standards and optionals reproduced perfectly giving sharp, easy-to-read copies.

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VIBRIN

molds better products more economically!

VIBRIN'S *Right Up His Alley!*

The operator of this bowling alley in Westminster, B.C., insisted on the best-looking, best-wearing bowling benches possible. So Pacific Plasti-Glass Developments Ltd. came up with the best answer: VIBRIN. And that's the story line of a hundred stories about VIBRIN polyester resins reinforced with glass fibre. In one application after another, molded VIBRIN is improving on wood and metal — with important savings in the bargain.

VIBRIN requires neither heat nor pressure, and only the most inexpensive molds. Yet it offers great strength, light weight, corrosion resistance, and the colour of your choice.

Naugatuck technical representatives are at your service, and the facilities of our development laboratories are available to help you evaluate Vibrin — to improve present products or to create new ones. Simply contact Naugatuck Chemicals at Elmira, Ont., or our branches in Montreal, Toronto, Winnipeg or Vancouver.

Other NAUGATUCK Plastics

Vibramix — Polyester Premixes
Kralastic — Styrene Copolymers
Marvinol — Vinyl Resins

Naugatuck Chemicals
DIVISION OF DOMINION RUBBER COMPANY LIMITED

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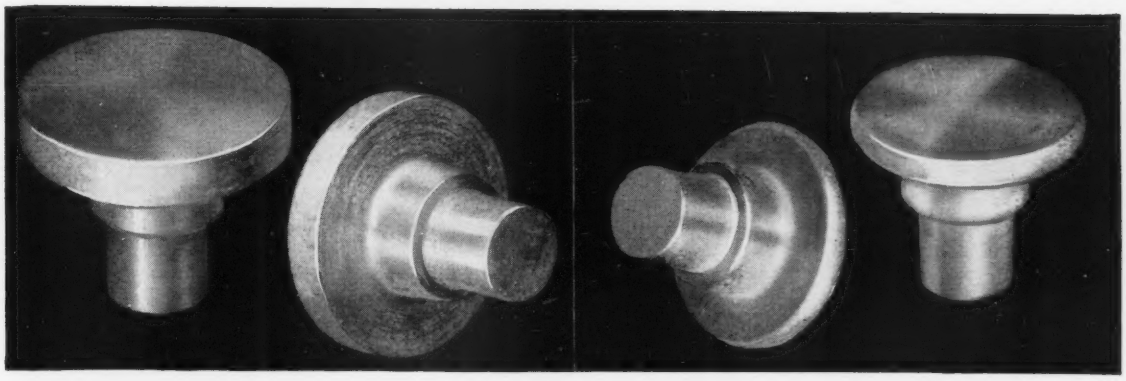
TO SAVE ON **FASTENERS**

Standardize your Specials

THROUGH STELCO COLD HEADING



Machined "Special" . . . slightly redesigned as a Cold Headed "Standard"

The simple Flat Head Shoulder Rivet shown on the left above (enlarged), was slightly amended as seen on the right, to permit production by cold heading instead of by machining. The elimination of scrap loss, combined with increased speed of production, brought a saving of 80% to the purchaser.

Pictured below are several other "specials" standardized by Stelco with considerable cost reduction.

57121.B

Result - 80% Savings!

Stelco's modern bolt-making facilities, plus the services of Specialty Fastener Representatives, offer you three ways to save on "special" fasteners —

FIRST — Many types of contoured parts can be produced by cold heading more economically than by machining. Not all savings are as impressive as the one illustrated above, but *cost reductions in the region of 40% are not uncommon* and are often accompanied by minor redesigning which adds to the strength of the part. Secondary operations, such as thread rolling or cutting, knurling, extruding, flattening, piercing, drilling, broaching, and bending are also provided for in Stelco's facilities.

SECOND — Stelco will carry as stock items your long-run repetitive "specials" — giving you a ready source of supply and the benefit of large-quantity prices.

THIRD — Your "special" requirement might already be in stock as a Stelco "Standard" — or possibly an existing "special" could meet your needs. In either case you would realise a saving.

Why not ask Stelco's Engineers to examine *your* "specials"? If they are adaptable to production by the cold heading process your cost reductions will be substantial. Any Stelco Sales Office is at your service.

THE STEEL COMPANY OF CANADA, LIMITED

Executive Offices: Hamilton and Montreal

Sales Offices: Halifax, Saint John, Montreal, Ottawa, Toronto, Hamilton, London, Windsor, Winnipeg, Edmonton, Vancouver. J. C. Pratt & Co. Limited, St. John's, Newfoundland.

Circle number 156 on time saver card

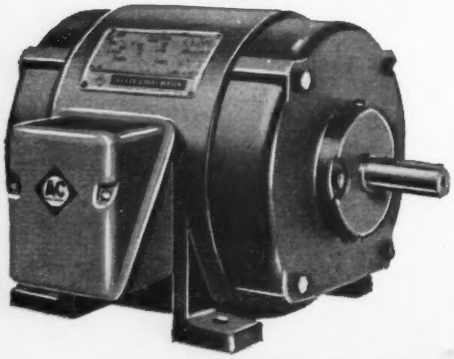
SILCO-FLEX

New Concept in Insulation

THE *Silco-Flex* insulating system, providing motor and generator stator coils with an almost impervious dielectric barrier, is a revolutionary departure in the insulation art. Introduced commercially by Allis-Chalmers in early 1955, this remarkable insulation has already caused a complete re-evaluation of motor enclosure and protection practices. It assures extended life and dependable operation of motors and generators under the most adverse service conditions, with a minimum of mechanical protection . . . opens the way to a savings of millions of dollars by users of motors and generators.

FOR LARGER MOTORS & GENERATORS

FOR SMALLER MOTORS



ENCAPSULATED STATOR

For motors in which random-wound coils are used, Super-Seal motors incorporate an encapsulated stator. A tough, durable case of epoxy resin encloses the winding end turns of the stator, as well as the slot portions. This process results in a stator completely impervious to moisture and fully resistant to attack by oils, solvents and most chemicals. This insulation is available in class A and B systems.

For further information contact your nearest CA-C sales office or write direct to:

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CANADIAN ALLIS-CHALMERS

55 BURWELL ROAD, ST. THOMAS, ONTARIO

59-M-1

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Anaconda Products Are as Canadian as the Maple Leaf

don't just say copper... say anaconda

Canadian industries find that ordering just "copper" is not enough. They know the value of dealing where the customer's interests come first. And, so, they specify *Anaconda* Copper!

Established here in 1922, Anaconda produces Canada's widest range of copper and its alloys, in the form of sheet, strip, tube, rod, special wire and extruded shapes.

When you say "Anaconda" you get the best products—made from metals mined and refined in Canada—Ontario copper and nickel, British Columbia lead and zinc, Manitoba zinc.

C-5921

ANACONDA
Copper and Brass
TRADE MARK

Anaconda American Brass Limited, New Toronto (Toronto 14), Ont. Sales offices, Montreal and Vancouver.

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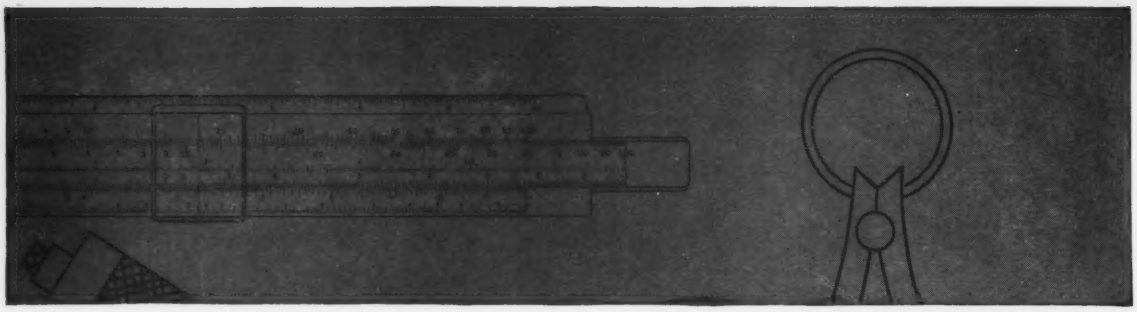
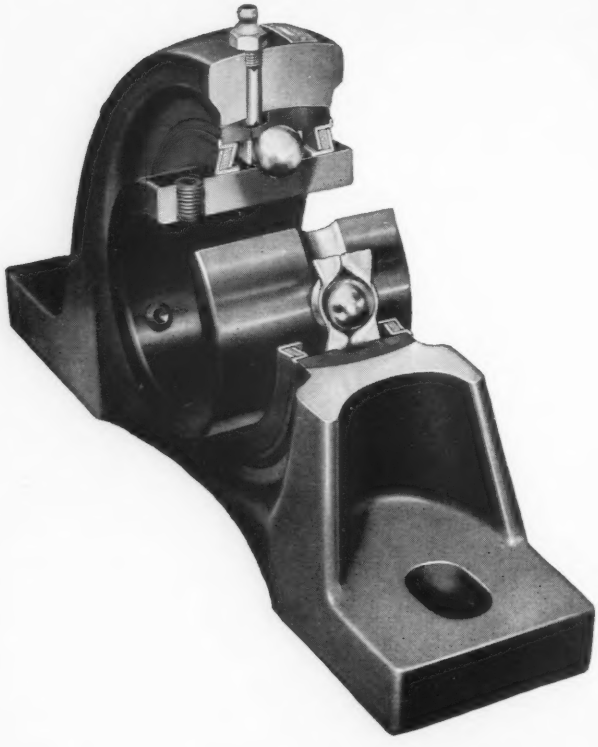
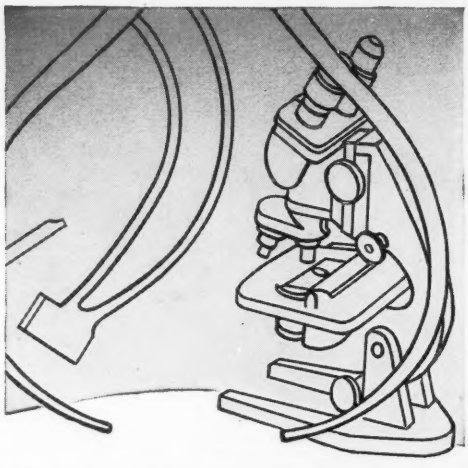


SYMBOLS OF PRECISION





Like the Movement of a Fine Watch...SEALMASTER Bearing Units Are Precision Built!

No component you buy for the products you build or operate will be more precisely engineered than the SEALMASTER Ball Bearing Units. From design boards to finished product SEALMASTER Bearings are the product of quality materials and manufacturing processes. Every bearing unit before leaving the SEALMASTER plant has been checked and rechecked to be certain it is worthy of bearing the SEALMASTER trademark. This insurance of quality has made the word SEALMASTER symbolic with Precision wherever bearings are used.

Write for your FREE copy of SEALMASTER Catalog 454.

S234C

SEALMASTER BEARINGS A DIVISION OF STEPHENS-ADAMSON MFG. CO. OF CANADA LIMITED, BELLEVILLE, ONTARIO

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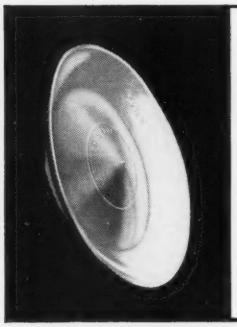
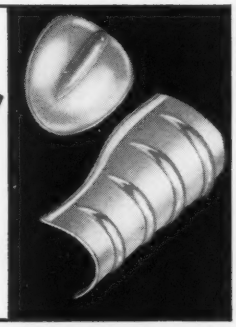
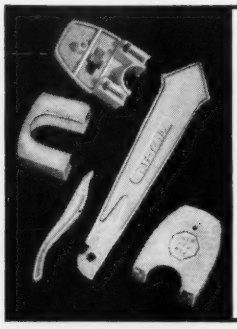
Fortilene† for fun!



Scepter-Spinner
A sensational new toy for amateur jugglers. So easy to spin, and so much fun. Made of unbreakable Fortilene by Scepter Manufacturing Co. Ltd.

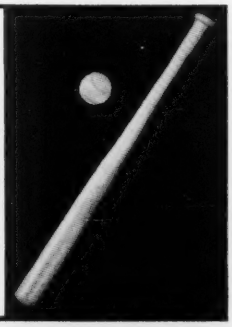
Hockey Pads
Made to withstand the toughest treatment. Their high impact strength gives ideal protection. Made of Fortilene, by Trans Canada Plastics Ltd.





Bicycle Directional Signals
Designed to ensure safety—sturdily built to last as long as the bicycle. Another Fortilene application by Plastene Co. for M.R.F. Enterprises.

Baseball and Bat
Regulation size!
An ideal lightweight baseball set that can't hurt the kiddies! This durable "Lido Champ" is merchandised by Lido (Canada) Reg'd.



Nothing beats the durability and attractive appearance of toys and sporting goods made of Fortilene. This plastic is extra tough, rigid, and resistant to chemicals; it has high impact strength, and good weathering characteristics.

FORTILENE could be best for your plastic application – contact:

CANADIAN CHEMICAL COMPANY, LIMITED
MONTREAL • TORONTO • VANCOUVER

†Reg'd. Can. Trademark.

Chemcell®
PLASTICS

Circle number 115 on time saver card

NEW...
from Skinner!

3-way, high-flow, solenoid valves for general industrial use

Main orifice sizes: full effective—⅜", ½", ¾" for ⅜", ½", ¾" NPT.

Standard operating pressures: 5 to 150 psi.

Media: oil, air, water, vegetable and petroleum oils, inert gases, kerosene, gasoline.

Types: normally open, normally closed and directional control in standard and explosion-proof construction.

These new, 3-way L3 Series valves, like all Skinner valves, are built to UL standards. Their bodies are made of forged naval brass and their internal parts are stainless steel and brass. Soft, synthetic inserts and seals provide bubbletight sealing. And a unique, Buna-N coated nylon diaphragm assembly assures long life. The valves are compact, light, and mount in any position, directly to the line. They are offered in a wide range of voltages and frequencies, with many electrical options and manual override.

Typical applications: air vises, chemical process equipment, presses, water treatment equipment, industrial machinery, packaging machinery, air and hydraulic cylinders, laundry machinery, etc.

Skinner has a wide selection of solenoid valves for all types of applications. If you have a control problem, please contact the following Skinner distributors or write us at the address below, Dept. 357.

Cowper Co., Ltd.
515 Fourth Avenue, Lachine
Montreal, Quebec

Dycon Limited
21 Carson Street
Toronto, Ontario

C. M. Lovsted & Co., Ltd.
1726 West 5th Avenue
Vancouver, B. C.

Petro-Automation Industries, Ltd.
P. O. Box 72
Edmonton, Alberta

SKINNER ELECTRIC VALVES

THE CREST OF QUALITY **THE SKINNER ELECTRIC VALVE DIVISION • NEW BRITAIN, CONNECTICUT**

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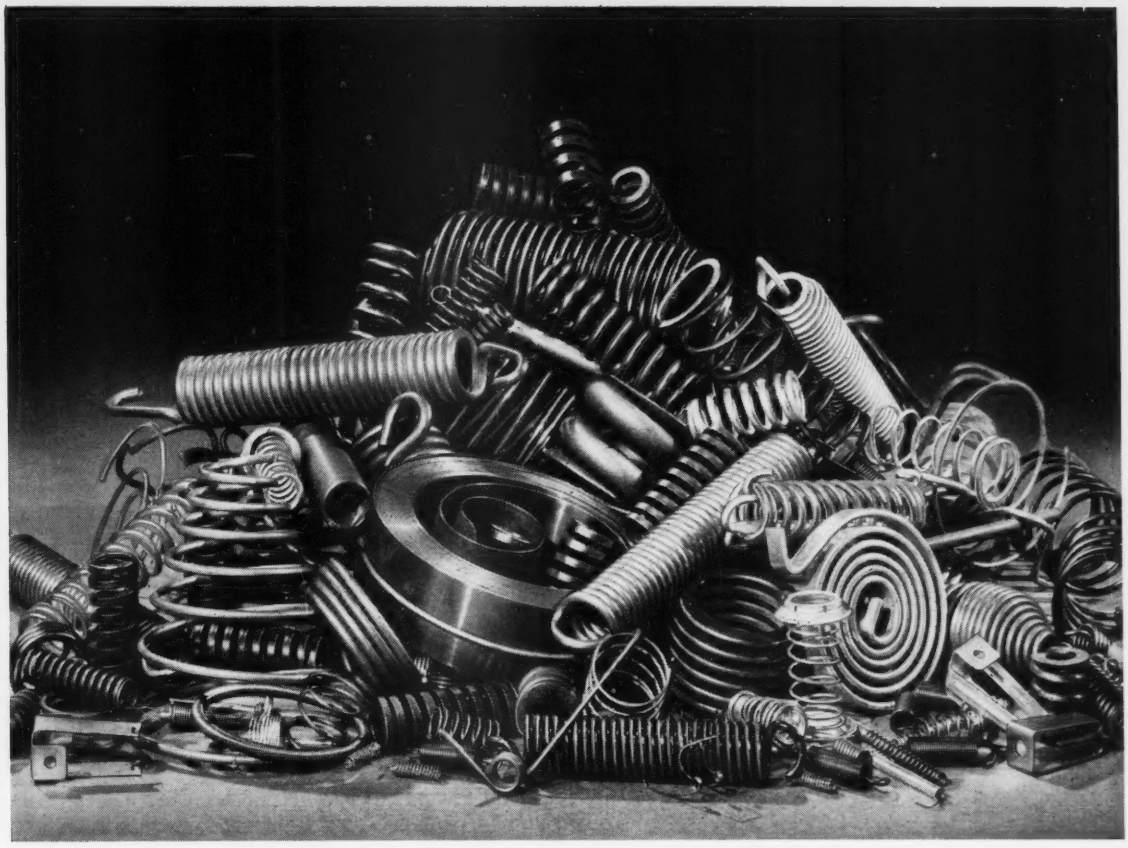

needle in a haystack?

Finding just the right spring can be costly and time-consuming. Even though springs look alike, each is different—depending on the job it has to do. Type, size, tension, temper, stress, and other complicating factors must be considered in their design and manufacture.

If finding the right spring for *your* problem seems like "looking for a needle in a haystack," let the man from Wallace Barnes help you. Our spring engineers are ready to accept your precision mechanical spring problem and help design the *right* spring to do your job *precisely* right.

Send for your free copy of
Spring Design and Selection—in Brief
our authoritative digest on spring engineering

Selecting the right spring is simple . . .

Just call the man from

The Wallace Barnes Company Ltd.

Hamilton, Ontario—Montreal (Pointe Claire) Quebec

Sales Agent: E. A. Tipping Sales Ltd., Winnipeg—Vancouver (Richmond)

Subsidiary of Associated Spring Corporation

64-205R

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offers a distinctive

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in the field of Industrial application of electronics.

The areas of industrial technology with which we are concerned are:

Nuclear Reactor Electronic Controls
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An individual who possesses an advanced academic background, experience in some of the above fields and a demonstrated ability is required for an executive position in charge of our Development Engineering Group.

Continued growth in our Radar Activities affords Electronic Engineers experienced in Microwave circuits, wide band receivers or radar systems, an opportunity for complex assignments on most recently developed techniques in GROUND, AIRBORNE or DOPPLER RADAR.

Interested parties should contact the Chief Engineer at —

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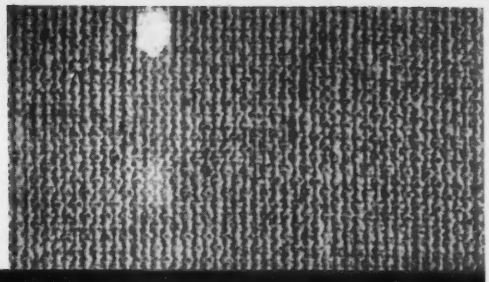
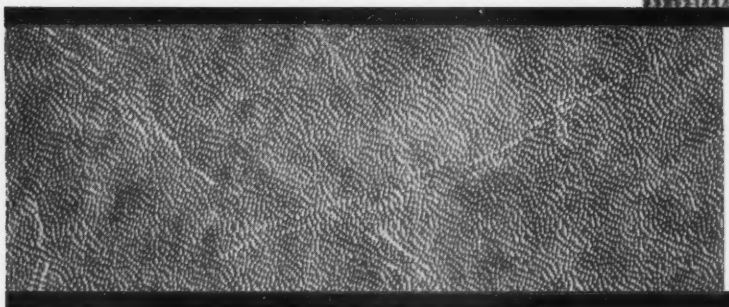
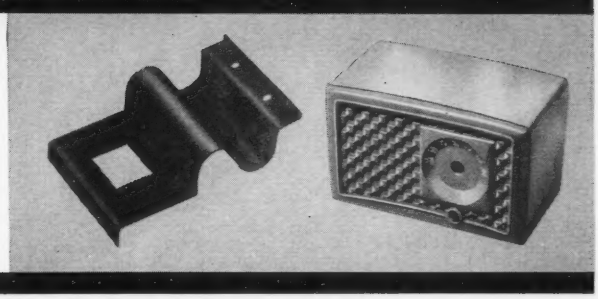
KLADKOIL





what it is...

what it can do!



...bonded textures on metal

Virtually indestructible, KladKoil is a vinyl plastic finish bonded permanently to a steel or aluminum base by a special process exclusive to Hunter Douglas Ltd.

KladKoil can be rolled, drawn, stamped or formed into intricate shapes without fracturing or cracking. It's so flexible, the metal will break before the finish does!

KladKoil is available in a variety of rich, warm textured colors. In the standard smooth finish, in paint or vinyl, an unlimited color range is available.

You fabricate with KladKoil without delay because it comes to you pre-finished!

Radio cabinets, appliances, business machines, automobile accessories and so many other products look better, last longer, sell faster when made of KladKoil.

For informative brochure, write to:—

KT922

HUNTER DOUGLAS LTD. *9500 ST. LAWRENCE BLVD., MONTREAL*

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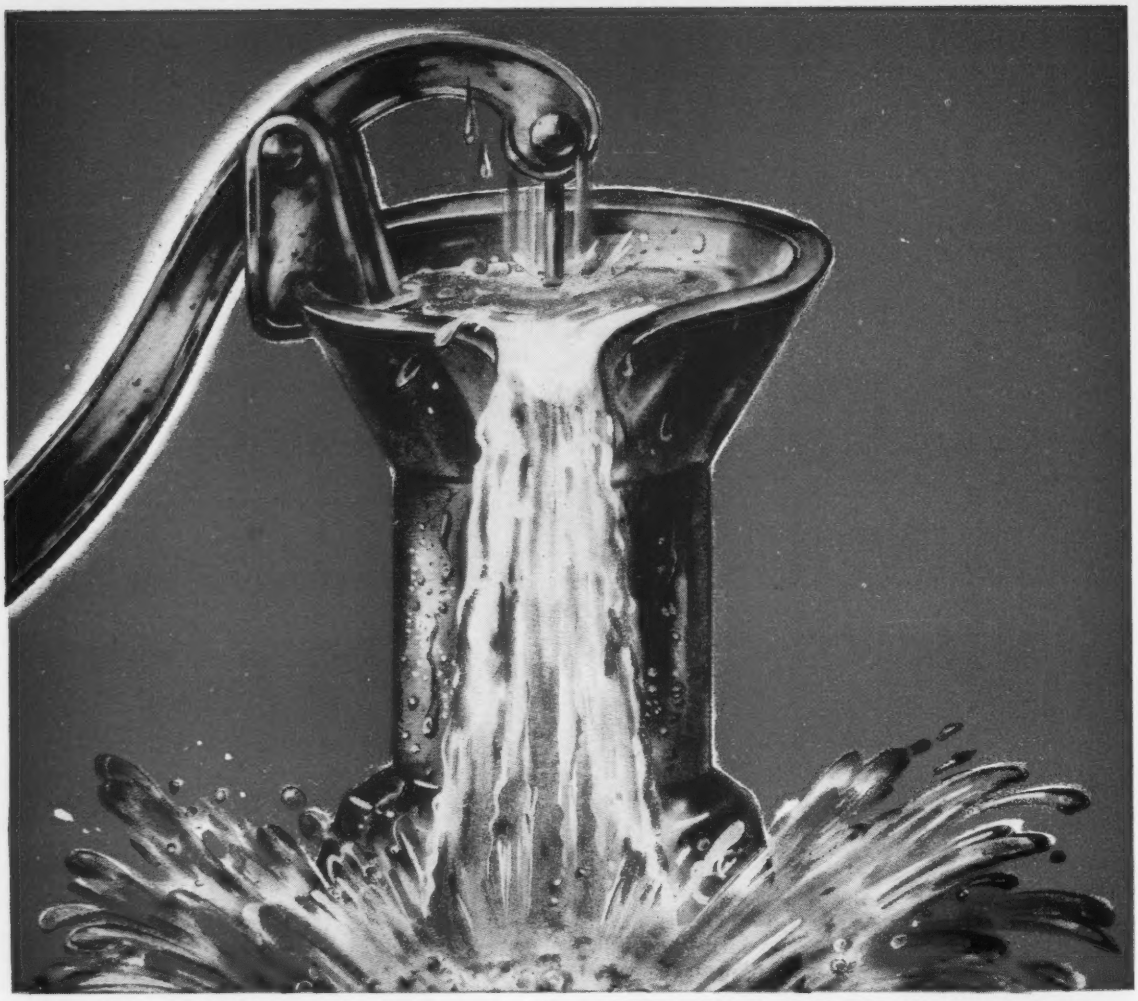
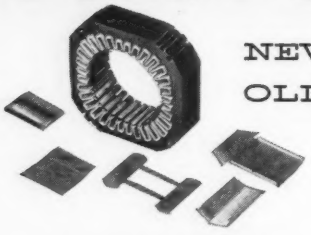


MOISTURE RESISTANCE



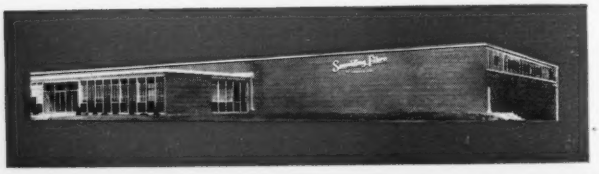
Special Properties:
Dielectric Strength – 110 volts/mil after 4 hours total immersion in water.

NEW SPAULDING 33 INSULATION LICKS AN OLD PROBLEM IN ELECTRICAL MOTORS

New Spaulding 33 is a superior electrical insulation for motors operating under conditions of high humidity or moisture collection, such as fan, air-conditioner or "splash proof" installations.

Spaulding 33 maintains high dielectric strength even when completely immersed in water due to a unique new treatment of its 100% rag paper base which prevents moisture absorption after edges have been cut.

We will fabricate **Spaulding 33** to your specifications. It is also available in sheets, rolls and strips.



BUY CANADIAN – BUY SPAULDING

Spaulding FIBRE OF CANADA LIMITED

OFFICES AND PLANT

70 Coronet Rd., Toronto 18, Ontario-Belmont 3-2151
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Phenolics Custom-Molded by

CANADIAN GENERAL ELECTRIC

ARE THE LOGICAL ANSWER

FOR MANY OF TODAY'S

COMPONENT PARTS

This dryer fan blade unit and sturdy caster illustrate the diverse types of component parts made of "Bakelite" phenolic molding compounds and produced by the Custom-Molded Plastics Division of Canadian General Electric.

The advantages of this quality plastic material in making component parts are numerous. It is economical, durable, light-weight, dimensionally stable, easily machined, of good appearance, and needs no surface finishing. These advantages warrant a review of your present component parts.

In the design-engineering stage of new component parts, the use of custom-molded phenolic compounds could also prove to be the most practical solution.

For detailed information and quotations on custom-molded plastics, contact Canadian General Electric Company Limited, Cobourg, Ontario.

'BAKELITE' Phenolic Compounds

UNION CARBIDE
TRADE MARK

BAKELITE COMPANY
Division of Union Carbide Canada Limited
TORONTO • MONTREAL • VANCOUVER

"Bakelite" and "Union Carbide" are trade marks

A CHIEF SUPPLIER OF PLASTIC RAW MATERIALS TO INDUSTRY

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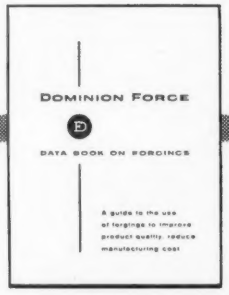
D Service

The duplicated facilities at Dominion Forge
are another reason for the big extras in forgings
Dominion delivers at no extra cost to you

Multiple equipment is the forging user's best guarantee of "on time" delivery and quality forgings at a consistent price. You can count on all three when your supplier is Dominion Forge, one of North America's great forges.

Dominion's forging and auxiliary equipment is not matched for versatility by any other commercial forge on the continent. Any down-time for repairs and maintenance with which Dominion Forge has to contend never slows Dominion's production, hence never interferes with yours. It's another reason for the big extras in forgings Dominion Forge delivers *at no extra cost to you!*

Whatever you require in forgings—from 15 to 150,000 of one design, in sizes from an ounce to over 300 pounds—your Dominion Forge *forging engineer* is trained to help you get *all* the extras in forgings. You're invited to call on his experience.


DOMINION FORGE
DATA BOOK ON FORGINGS
A guide to the use of forgings to improve product quality, reduce manufacturing cost

YOURS FREE! Every user of forgings ought to have a copy of Dominion's **DATA BOOK ON FORGINGS,** a handy, informative guide, loaded with facts about forgings. Also described and illustrated is Dominion's multiple equipment. Write for your copy.

BOARD HAMMER OPERATOR Danny Romano and over 125 other members of Dominion's Quarter Century Club are representative of the forging experience available to you.

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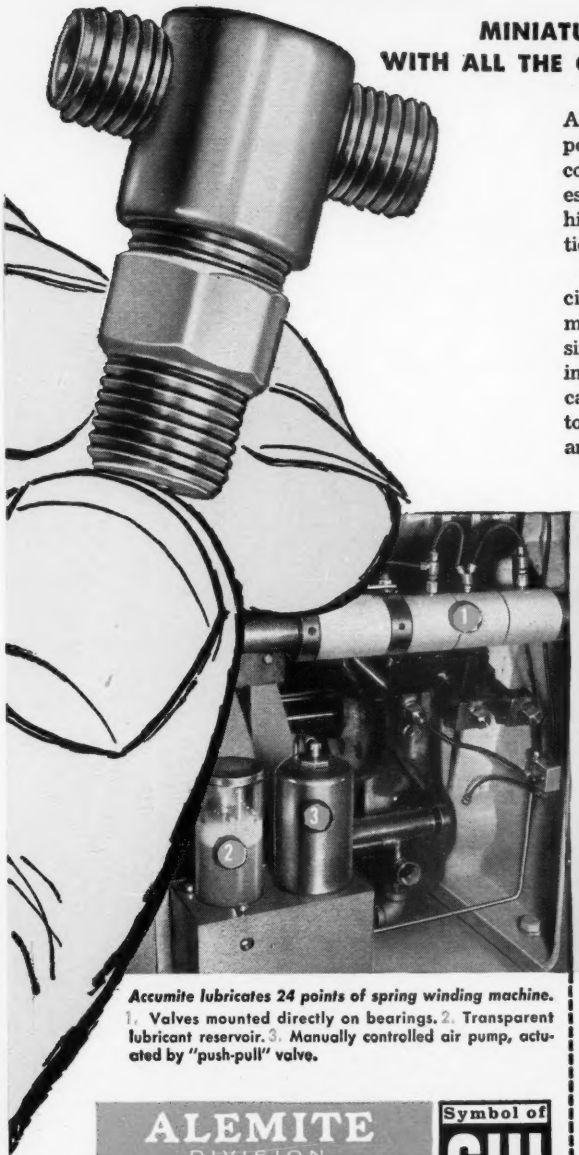
NOW! Any Machine Can Have The Advantages of Centralized Lubrication... At Low Cost!

Alemite "MINIATURE" ACCUMITE® System



MINIATURE SIZE FOR LIMITED SPACE — WITH ALL THE QUALITY OF HIGHER-PRICED SYSTEMS!

Alemite—with 40 years of centralized lubrication experience—announces an all-new miniature system complete with pump, metering valves and controls—especially designed to service many machines and vehicles where centralized lubrication has been impractical until now!

Alemite's new midget-size Accumite system is especially adaptable to light, precision, multiple-bearing machines that have limited installation space. Its small size and simple installation overcomes cost limitations in most plants. Typical applications are: packaging, canning, labeling and textile machines . . . and machine tools. It is also suitable for tractor trailers, lift trucks and farm implements.

Accumite lubricates 24 points of spring winding machine.
1. Valves mounted directly on bearings. 2. Transparent lubricant reservoir. 3. Manually controlled air pump, actuated by "push-pull" valve.

ACCURATELY METERS THESE SHOTS OF OIL OR GREASE

.003 cu. in. .006 cu. in. .009 cu. in.

ALL THE ADVANTAGES OF "BUILT-IN" MEASURED LUBRICATION—PLUS MIDGET SIZE!

- Meters exact amounts of refinery-clean lubricants to all bearings whenever system is operated.
- Eliminates shutdown time for lubrication.
- Seals lubricant against dirt, grit and water.
- Prevents bearing troubles due to neglect or use of wrong lubricants.
- Services all bearings in one operation.
- Avoids work spoilage and bearing repairs due to overlubrication.

Mail coupon for full information!

Alemite Division of Stewart-Warner Corporation of Canada Limited, Belleville, Ontario.

Please send me all the facts about your new "Miniature" Accumite system.

Name.....

Company.....

Street.....

City.....Prov.....

ALEMITE DIVISION
STEWART-WARNER CORPORATION
BELLEVILLE, ONTARIO

Symbol of SW Excellence

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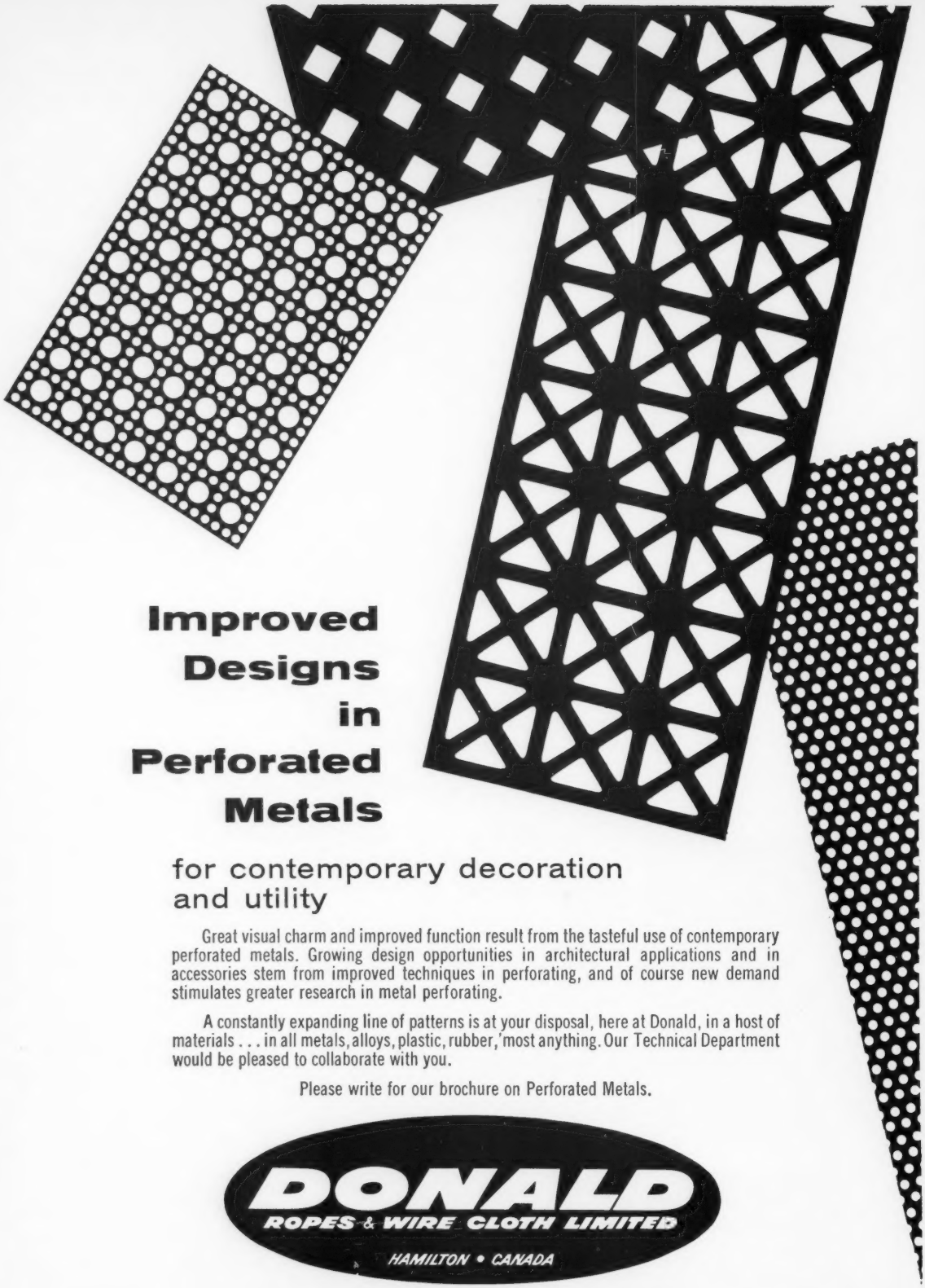


Improved Designs in Perforated Metals

for contemporary decoration and utility

Great visual charm and improved function result from the tasteful use of contemporary perforated metals. Growing design opportunities in architectural applications and in accessories stem from improved techniques in perforating, and of course new demand stimulates greater research in metal perforating.

A constantly expanding line of patterns is at your disposal, here at Donald, in a host of materials . . . in all metals, alloys, plastic, rubber, 'most anything. Our Technical Department would be pleased to collaborate with you.

Please write for our brochure on Perforated Metals.

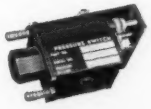
DONALD
ROPES & WIRE CLOTH LIMITED
HAMILTON • CANADA

Other offices and warehouses in Montreal, Winnipeg and Regina. Field representatives all across Canada.

D-79

Circle number 125 on time saver card

Wonders in Miniature. Snowflakes are excellent examples of how Nature uses tiny things to achieve great effects. Individually, these microscopic crystals are masterpieces of symmetrical beauty. Collectively, they have a decided influence on this planet's living conditions. Man follows Nature's lead by using miniaturization as a powerful force of action.



Miniature Pressure Switch, approximately 1¾″ long, has exceptionally high resistance to radiation. It maintains performance characteristics and calibration at 1000°F and in a reactor environment, operating in lines up to 10,000 PSI, with no seepage or leaks. Construction includes two MPB bearings to support movement of highly sensitive member.

Man With Miracles. Gordon Colson, an MPB Sales Engineer, worked closely with the firm producing the small high-pressure switch. He provided technical assistance for their engineers in selecting exactly the right bearings. To aid in solving your engineering problems with miracles in miniaturization, an experienced MPB technician is available.

New Miracles in Miniaturization

ACTUAL SIZE OF THE BEARINGS IN PRESSURE SWITCH SHOWN ABOVE

Reaching new heights, in outer space or in everyday industrial efficiency, calls for a good deal of new equipment, which usually calls for new miracles in miniaturization. And which, in turn, calls for experience like MPB's in making smaller bearings to meet greater scientific and industrial needs. MPB has specialized in this and produces over 500 types and sizes of bearings, ranging down to 1/10″ O.D., with specials as required. Our catalog will bring you complete facts on these. For catalog, or engineering advice, or both, **write MPB distributor. Lyman Tube and Bearings, Ltd.,** 920 Ste. Sophie Lane, Montreal. Additional offices: Toronto, London, Winnipeg, Vancouver and New Glasgow.

MINIATURE PRECISION

MPB

BEARINGS, INC.

Helps you perform miracles in miniaturization

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New from Du Pont

VITON®

a synthetic rubber with unequalled resistance to heat and fluids

VITON synthetic rubber combines high resistance to oils, fuels, solvents and corrosive chemicals with outstanding resistance to high temperatures — from 400° F. to 450° F. in continuous service and up to 600° F. in intermittent service.

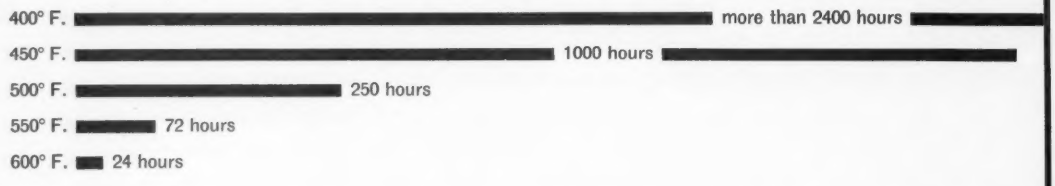
VITON has excellent mechanical properties . . . such as low compression set, high modulus and good tensile strength . . . plus resistance to ozone, oxygen and weathering.

VITON meets the need for a new rubber that will serve where ordinary synthetic rubbers fail. It offers the chemical processing industry such products as gaskets, O-rings, seals, coated fabrics, hose, tubing and a great variety of parts that will perform over an unusually wide range of operating conditions.

Ask your rubber goods supplier about VITON. For more information on its properties and uses write to: Du Pont of Canada Limited, Room 400, 85 Eglinton Ave. East, Toronto 12, Ontario.

VITON RESISTS HEAT

Periods of time for which VITON vulcanizates have remained usefully elastic when oven aged in air at the temperatures shown.



VITON RESISTS CHEMICALS

Data obtained by immersing VITON vulcanizates for 7 days and measuring effect on properties shown. Original properties of test compound; tensile strength, 2400 psi; elongation at break, 200%; hardness, shore A, 71; modulus @ 100%, 700 psi.

	Temperature	Tensile strength retained %	Volume increase %	Hardness change, points
Carbon disulfide	75° F.	98	1.2	−11
Carbon tetrachloride	75° F.	85	1.3	+ 2
JP-5 petroleum aircraft fuel	75° F.	100	0.4	+ 1
Sulfuric acid, fuming	75° F.	58	4.8	− 4
Dichlorobenzene	158° F.	81	10.5	−11
Sodium hydroxide, 50%	158° F.	89	5.1	− 8
Phosphoric acid, 60%	212° F.	93	0.5	0
Water	212° F.	98	2.7	+ 3
Sulfuric acid, 60%	250° F.	102	5.2	− 3
Petroleum oil, crude	300° F.	91	1.4	− 9
Oronite 8200 silicate ester	300° F.	93	1.8	0
Water	400° F.	45	4.0	+16

DU PONT CANADA

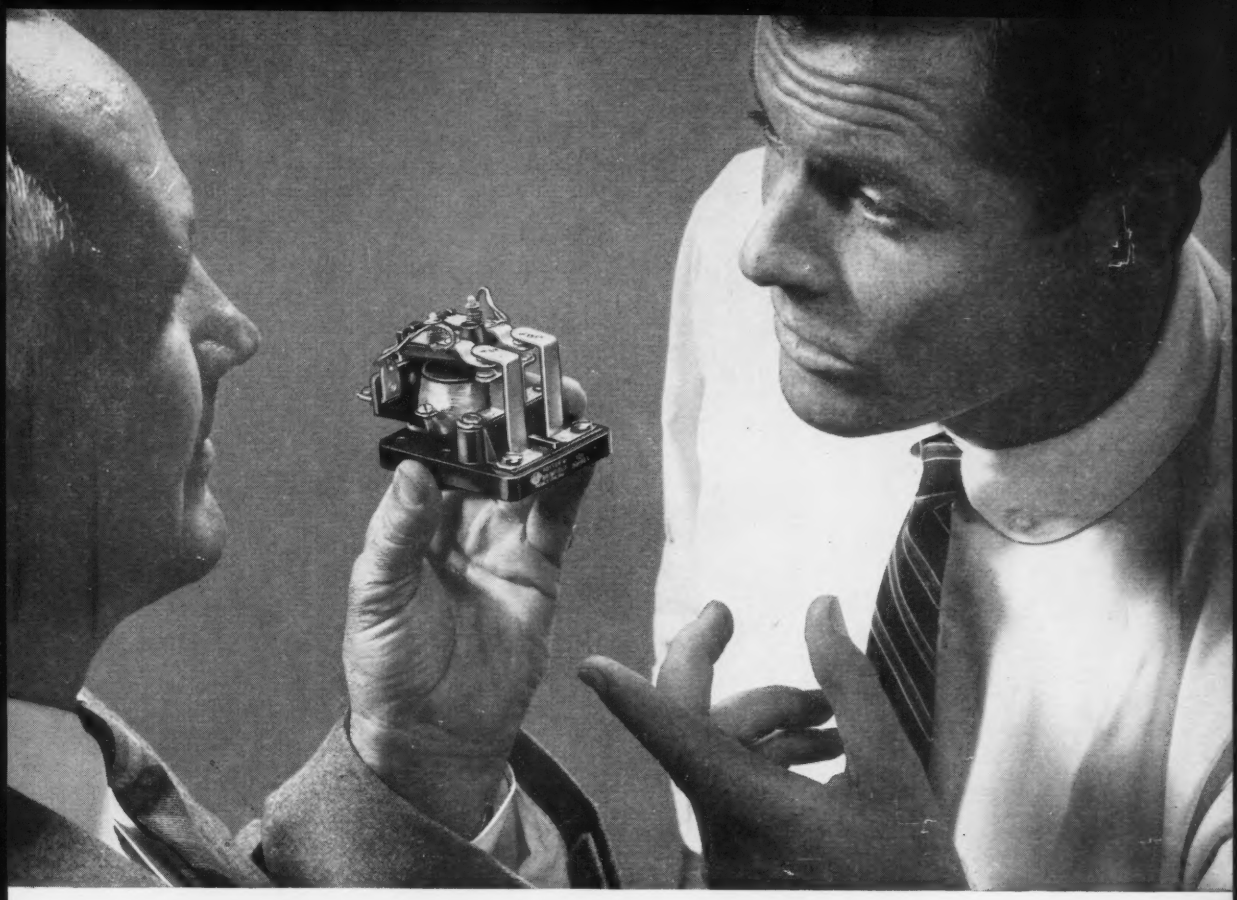
SYNTHETIC RUBBER

NEOPRENE
HYPALON®
VITON®
ADIPRENE®

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Registered trademark of E. I. du Pont de Nemours & Co. (Inc.)

Circle number 126 on time saver card



HERE'S WHY P&B's PR POWER RELAY IS PREFERRED

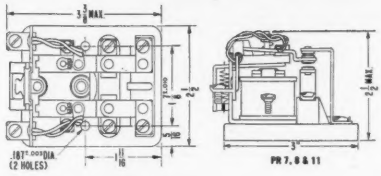
for high current/voltage switching

HEAVY DUTY construction means long-term dependability when switching up to 20 amperes (double break contacts). Here is a ruggedly built relay, packed with high quality features, yet economically priced.

The PR's full floating movable contact carrier, for example, provides excellent contact pressure and ample wipe for self-cleaning contact action. The coil is centrifugally impregnated with top-grade varnish to eliminate moisture traps.

Contact arrangements up to DPDT are available. The PR has been adapted for printed circuitry and heavy duty plug-in applications.

All standard AC actuated PR relays may carry the UL and Canadian Standards Association seals of approval. Write or call for complete information.



GENERAL SPECIFICATIONS:
Breakdown Voltage: 1500 volts rms min. between all elements and ground.
Ambient Temperature: DC: —55° to +85°C.
AC: —55° to +55°C.
Terminals: Heavy duty screw type. Standard printed circuit pins or plug-in on request.
Enclosures: PR dust cover.

CONTACTS:
Arrangements: Up to 2 Form C (DPDT).
Material: 5/16" dia. silver or silver cadmium oxide. (Others available)
Load: Single break: 15 amps; Double break: 20 amps at 115 volts 60 cycle AC resistive.

AUXILIARY CONTACTS:
Arrangements: 1 Form A, B or C.
Material: 3/16" diameter silver
Rating: 5 amps at 115 volts 60 cycle AC resistive.

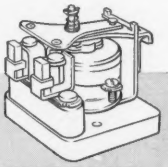
COILS:
Resistance: 64,000 ohms maximum.
Power: 1.8 watts DC; 9.8 volt-amps AC.
Duty: Continuous AC or DC (DC coils will withstand 10 watts at 25°C).
Insulation: Centrifugally impregnated with high quality varnish.
Mountings: 2 holes .187" diameter 1⅞" o.c.

PR Relays Approved By Underwriters' Laboratories and Canadian Standards Association

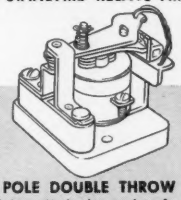
Type	Contact Arrangement*	Type	Contact Arrangement*
PR1AY	SPST-NO	PR5AY	SPDT
PR2AY	SPST-NC	PR7AY	DPST-NO
PR3AY	SPDT-NO-DM	PR8AY	DPST-NC
PR4AY	SPDT-NC-DB	PR11AY	DPDT

These relays are available in any of the following operating voltages: 6, 12, 24, 48, 115, 208, 230, or 440 volts 50/60 cycles AC.
The contacts are rated at: 13 amps, 115 volts AC. 6.5 amps, 230 volts AC. 1 hp for 115 or 230 volt AC motors.
Any relays deviating electrically or physically from these standard models will not carry U/L or CSA approval.
*Read: NO normally open, NC normally closed, DB double break, DM double make.

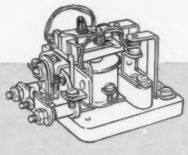
P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR



PR RELAY WITH MAGNETIC BLOW-OUTS
Models PR3 and PR7 can be supplied with alnico magnets to suppress arcs on DC loads over 1200 watts.



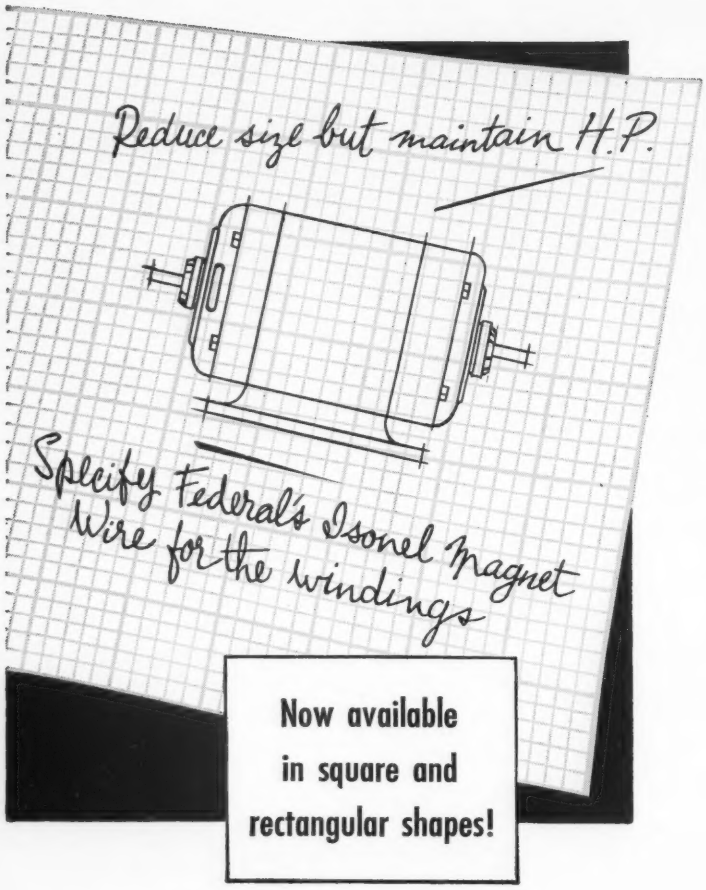
SINGLE POLE DOUBLE THROW VERSION
PR 5 (SPDT) has all the heavy-duty features of other models in this series.



PR WITH AUXILIARY CONTACTS
All PR models can be equipped with auxilliary contacts in 1 Form A, B, or C arrangements.

POTTER & BRUMFIELD CANADA LTD.
Guelph, Ontario

FEDERAL ISONEL
Solves High Temperature Motor Problems


Reduce size but maintain H.P.
Specify Federal's Isonel Magnet Wire for the windings
Now available in square and rectangular shapes!

The outstanding thermal properties of Federal's (Polyester) Isonel Magnet wire permit the operation of motors at higher temperatures—suitable for use at Class F (155°C) temperatures. This means the motor size can be reduced for a given horsepower, or greater horsepower can be obtained from a given size.

While having this advantage of higher operating temperatures, Federal's Isonel possesses the excellent heat shock, chemical and abrasion resistant properties of vinyl-acetal magnet wire. It has improved resistance to flow at high temperatures; and it does not craze, giving higher voltage breakdown and better shelf-life.

Available in Pay-Off Paks
13-23 in 250 and 500 lb.
24-29 in 100 lb. packs.

5901

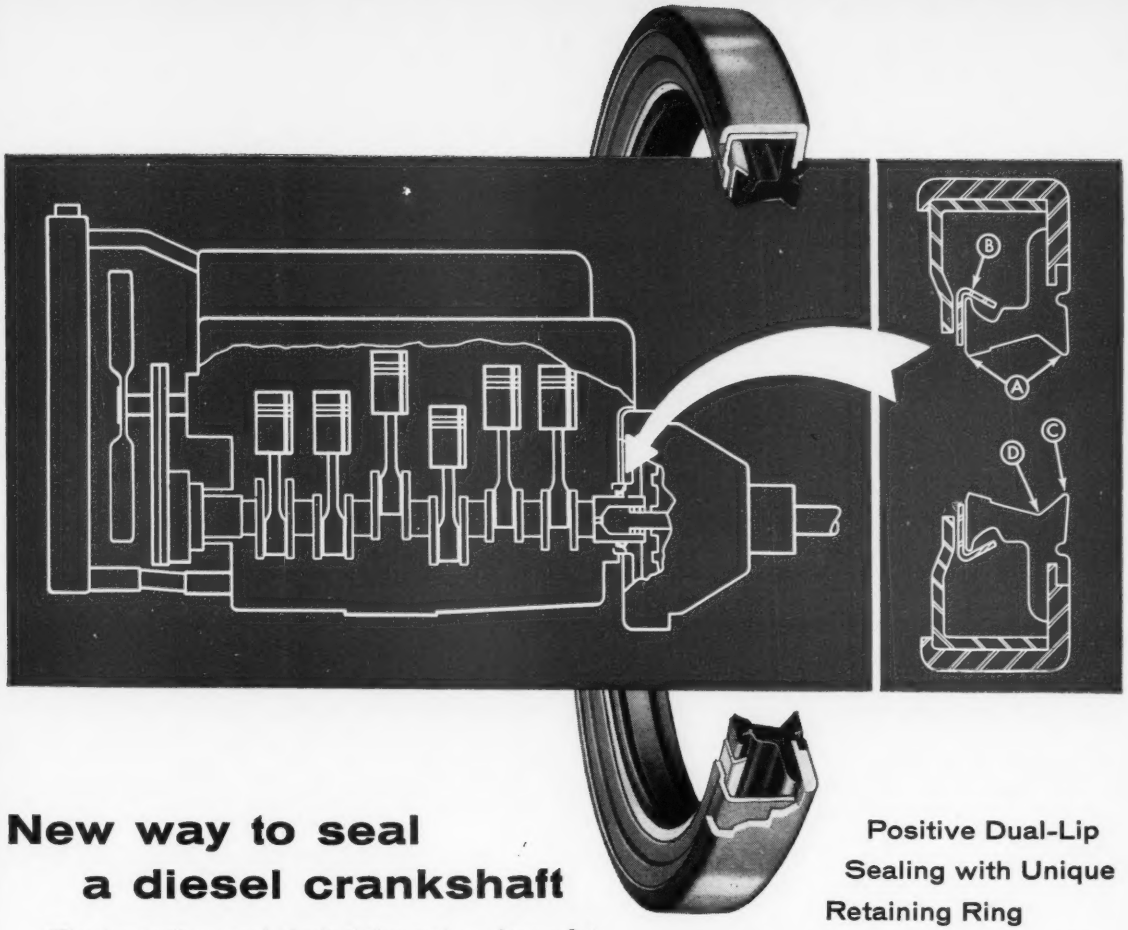
Specify Federal . . . for the best in Magnet Wire.

FEDERAL WIRE PORTER **& CABLE DIVISION**

H.K. PORTER COMPANY (CANADA) LTD.

DIVISIONS: Connors Steel, Delta-Star Electric, Disston, Forge and Fittings, Leschen Wire Rope, Mouldings, National Electric, Refractories, Riverside-Alloy Metal, Thermoid, Vulcan-Kidd Steel, H.K.Porter Company (Canada) Ltd.

Circle number 128 on time saver card



New way to seal a diesel crankshaft

The tremendous work loads being put on heavy-duty diesels call for a new look at sealing specifications. Stresses on the crankshaft often cause eccentricity with runout as much as .042 in. This makes holding a tight seal at the shaft rear extension with a standard seal design extremely difficult if not impossible. Another consideration is high working temperature—up to 300 deg. F.

Newest provision for this condition on a typical diesel is shown here. This unique yet simple modification of standard Victor oil seal design maintains positive mating of shaft and sealing element under any shaft divergence. The element—a silicone elastomer compounded by Victor—is good to 400 deg. F. intermittently.

In place of the usual garter spring, Victor engineers designed a unique retaining ring, loosely mounted over the sealing lip surface. The ring retains proper lip pressure while it permits the sealing element to follow the exact eccentricities of the shaft.

Have you a shaft sealing problem—or any problem involving oil seals or gaskets? Victor can help you solve it most economically. Contact your Victor Field Engineer or the factory. Victor Mfg. & Gasket Co. of Canada Ltd., St. Thomas, Ont. In the U.S.: Victor Mfg. & Gasket Co., Chicago 90, Ill.

Positive Dual-Lip Sealing with Unique Retaining Ring

A Basic design is Victor Type K6 with dual-lip standard construction. Provides maximum fluid retention and exclusion of foreign matter. Sealing element is silicone rubber, integrally molded and bonded to steel case.

B Metal retaining ring loosely mounted over the lip replaces usual garter spring. Allows expansion of element when seal is installed on shaft, yet confines element and retains even lip pressure in operation.

C Outer or secondary lip is molded with very little interference, avoiding danger of turning back lip on installation. When shaft enters primary lip, interference of secondary lip is increased through lever action.

D Lubricant applied between lips before installation permanently lubricates the seal, reduces frictional drag, extends seal life.

VICTOR

Sealing Products Exclusively

A complete reference manual for designers—Victor Oil Seal Engineering Catalog No. 305. Sent on request.

GASKETS • OIL SEALS • PACKINGS • MECHANICAL SEALS

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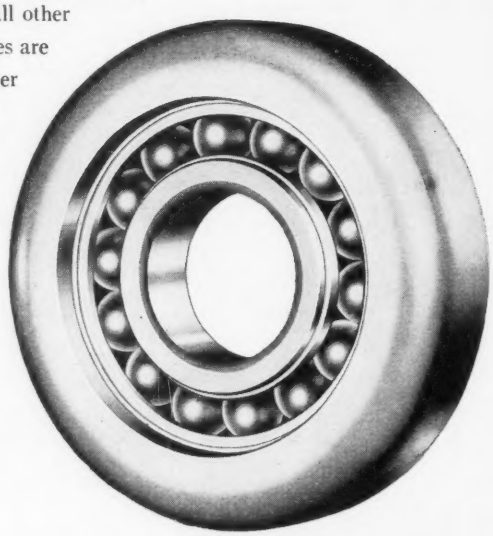
For Endurance . . .

It's the NEW HEIM *Unibal*® Ball Bearing

Simplified construction and an entirely new method of ball bearing manufacture represents a great stride forward in anti-friction bearing design. A solid outer race with deep, continuous, unbroken ball groove; and a solid inner raceway with matching ball groove made to fit around a full complement of balls. This eliminates the necessity for loading slots, split raceways, separators, and all other extra and costly assembly devices. The ball grooves are burnished, deep carburized, and hardened. The inner and outer raceways are machined to a smooth finish; the result is quiet, smooth operation, longer bearing life, greater load capacities, and lower costs.

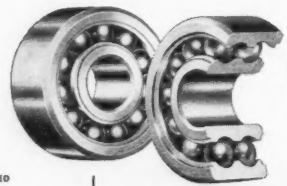


The design possibilities in this new Heim method of construction are almost unlimited. One example is this 4″ heavy duty bearing for high radial and axial load conditions.

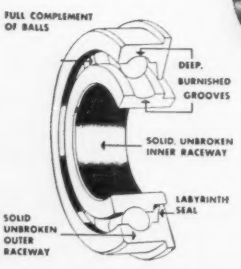
Bearings with plain outer members in small sizes.

. . Medium sizes or sizes to 2″ diameter and over

Bearings with flanged outer members in all sizes



Double row type bearings.



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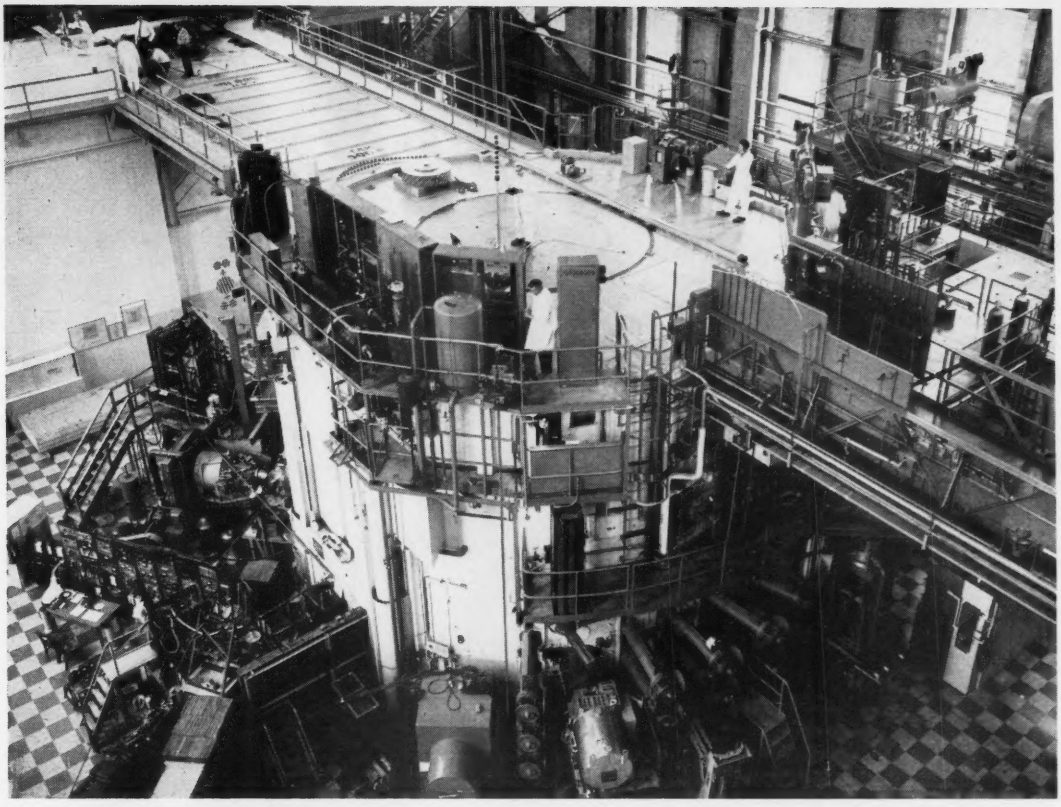


The 40,000 kw (thermal) NRX at Chalk River is fuelled with natural uranium, moderated with heavy water.

The organization of research in Canada

R. A. Lay, B.A.

Scientific research in Canada is characterized by a degree of flexibility unique in organized science.

In all scientifically active countries, the central government is responsible for developing every aspect of the scientific effort. In Canada this has been achieved in such a way as to combine efficient use of scientific resources with freedom of operation.

The only pressures exerted on Canadian research are the demands of fundamental investigations which advance human knowledge, and the scientific and technical requirements of developing industry.

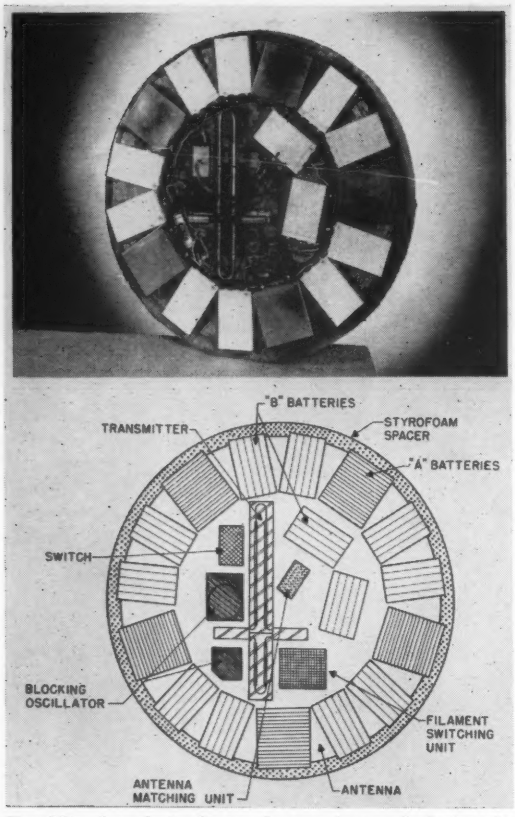
The National Research Council was set up by an Act of Parliament in 1916 to stimulate all phases of scientific research in Canada, and to link science with industry.

Its creation marked the beginning of organized science in Canada. The universities at that time were almost entirely absorbed in undergraduate work. Professors had no time, and the universities no money, to spend on research. There was no scholarship program to assist graduate students. Most of the graduates went abroad for further study, and many of them did not come back. Industrial research was practically nonexistent. A few government departments had set up laboratories, but these were engaged in solving practical problems. It was not a stimulating picture.

To correct this situation, the Council initiated a three-fold program. To encourage scientific training in the universities (which it regarded as its most urgent task), it established a system of graduate scholarship. To support research in the universities, it began a system of grants in aid of research. To co-ordinate research on a national scale, it set up a number of associate committees. These three devices proved so effective, they are still in use, and in 1958-59 the council made research awards worth $5.9 million.

The National Research Council is not a government department, and is not connected to one. It reports to a Committee of the Privy Council on Scientific and Industrial Research. The Council consists of 21 members, of which the president and three vice-presidents are paid officials. The other 17 members are chosen from leading scientists in Canadian universities, representatives of industry and labor.

continued



Tumbling low drain distress beacon for crashed aircraft.

All matters of Council policy, including selection of staff and the awards program, are decided by the Council itself. Council revenue devolves to the Council rather than into general government income, and may be carried from one fiscal year to another in a special account. This means that Council finances are not entirely dependent on parliamentary money votes.

The creation of independent government laboratories was urged by the early National Research Council. It was felt that this would stimulate the general research effort through fundamental research and through asisstance to industry. Laboratory work was begun in 1927, and organized on a much larger scale in 1932. During the depression years, little expansion was possible, but a nucleus of highly trained specialists was built up in all fields of science. With the demands made on them for military research of all kinds during World War II, the research facilities grew rapidly.

The Council now has nine laboratory divisions — applied biology, applied chemistry, pure chemistry, applied physics, pure physics, building research, mechanical engineering, the National Aeronautical Establishment, and radio and electrical engineering. There are also two regional stations — the Prairie Regional Laboratory at Saskatoon, and the Atlantic Regional Laboratory at Halifax. Medical research is supported in hospitals and other institutions by the Council's Division of Medical Research.

Fundamental work is strongly supported in the Council laboratories, but slightly more than 50% of the effort is devoted to applied research. This work may be instituted by the Council or requested by industry. A further aid to industry is the Council's Technical Information Service which provides existing technical information free of charge to industrial and other organizations. The Council's library is the largest collection of scientific material in the country. It has assumed the function of a national science library.

Canadian Patents and Developments

Canadian Patents and Developments Limited is a Crown Company established in 1948 as a subsidiary of the National Research Council. The Company's primary purpose is to make available to industry, through licensing arrangements, new processes and improvements in processes developed by the Council's scientific workers.

As an ordinary company, CP&D enjoys an easier relationship with its ordinary company clients than would be possible for a government department. It now handles licensing arrangements for several departments, and for the Provincial Research organizations. The Company also looks after inventions arising from government development contracts which are the property of the government.

CP&D's services have also been made available to Canadian universities. Because their position is different from that of the government departments, separate agreements have been made with them regarding payment of royalties. Through cross-licensing agreements maintained with the National Research and Development Corporations of England and India, Canadian manufacturers can obtain rights on patents held by these agencies. Some work is done for the scientific organizations of other Commonwealth countries, too.

Atomic Energy of Canada

Atomic Energy of Canada Limited is a Crown Company which operates Canada's main centre for atomic research at Chalk River, Ont. Formed in 1952 to take over the atomic energy research established by the National Research Council, the Company's primary objective is the development of economic atomic power. It has, in addition to its salaried officers, a nine-man board of directors, made up of representatives of private industry, public and private power companies, and Canadian universities. Like the National Research Council, the Company reports to Parliament through the Committee of the Privy Council on Scientific and Industrial Research.

The main engineering development in the atomic power effort is being devoted to the natural uranium-heavy water type of reactor. An experimental atomic power station (called NPD for Nuclear Power Demonstration) is now under construction near Rolphton, Ont., in collaboration with the Canadian General Electric Company Limited and the Hydro-Electric Power Commission of Ontario. The station is expected to go into operation early in 1961, with an output of 20,000 kilowatts of electricity. A design study for a much larger station of 200,000 kilowatts is completed.

Besides the short-term investigations necessary for the design and operation of power reactors, the Company carries out extensive fundamental research in physics, chemistry, biology, and metallurgy.

Four reactors are now in operation at the Chalk River establishment: ZEEP (100 watts — a measure of heat produced), PTR (100 watts), NRX (40,000 kilowatts) and NRU (200,000 kilowatts). All are fuelled with natural uranium and moderated with heavy water, except PTR which has enriched uranium fuel

Organization of research

rods immersed in a pool of ordinary water.

NRX and NRU are used for fundamental research, for engineering development and for the testing of fuel-coolant systems for atomic power station reactors.

Defence Research Board

The Defence Research Board was established in 1947 to carry out research for the armed forces, and to co-ordinate their development requirements.

Prior to World War II, Canada had no organized defence research program, although limited work in ballistics and radio and chemical warfare had been carried out for the Department of National Defence by the National Research Council.

During the War, the Council was officially named as the research establishment for the three armed services, and in addition to devoting its own activities exclusively to military problems, the Council co-ordinated the over-all defense effort in university, industrial and government laboratories. When it was decided, after the war, that military research and development should be continued to meet the future needs of the armed forces, the Defence Research Board was formed.

The Board is unique as an organization for defence research because it is civilian-directed and operated independently of the armed services. It is connected with them, however, within the framework of the Department of National Defence, and like the services, is responsible to the Minister of that Department. Board membership includes a representative of each of the three armed services, and the Chairman of the Board, in turn, has the status of a chief-of-staff, and attends meetings of the Joint Chiefs of Staff. Seven of the 16 Board members are ex-officio and are paid officials of other government agencies. The laboratory staff is civilian, and as in the case of the National Research Council, is selected by the Board itself. The Board also operates its own system of grants in aid of research.

Problems of importance to Canada, or for which Canada has unusual resources or facilities are emphasized in the Board's work. The research and development program includes investigations on weapons, armaments, electronics, environmental protection, naval and aeronautical research, data processing, operational and medical research. To carry out this work the Board operates 11 specialized research establishments located all across the country. Some of the work is done under contract with industry or universities, and some by the National Research Council. Various collaborative programs are undertaken with the United Kingdom and the United States.

Conclusion

The distinctive organizational form of research in Canada arises from an attempt to deal as efficiently as possible with Canada's scientific and technological needs. Although a government agency has been accorded the directive function in this development, the freedom which characterizes its operation has remained the distinguishing feature of the system. ★

Constructed by hydraulics laboratory of NRC's mechanical engineering division — a 1/30th scale model of lock.

Atomic Energy of Canada, Chalk River. Two large brick buildings (extreme right) are NRX and NRU reactors.

How Canada Compares with U. S. and U. K. in national R and D

Industrial Research and Development in Canada has grown rapidly from less than $5 million before World War II, to $149 million in 1957 and about $161 million in 1958.

Of these expenditures, $125.5 million, in 1957, and about $133.6 million in 1958, were for R and D done within the company reporting. An additional amount of $23.6 million in 1957 and about $27.4 million in 1958 was done by other firms or organizations for the reporting companies.

Of the $23.6 million in 1957, $19.8 million was for research and development done outside Canada. In addition, large amounts are paid, usually to organizations outside Canada, for the final products of R and D. These payments are in the form of royalties, payments for use of patents, for franchises or services or even reflected in the profits of the organization exploiting the results of R and D and are, of course, not included here. (See Table A.)

Total expenditure on Canadian industrial R and D in 1957 was 0.47% when measured in terms of Gross National Product. In the United States in 1956, industrial research was about $6.5 billion and over $7 billion in 1957, or more than 1.5% in terms of U. S. Gross National Products.

Thus industrial R and D expenditures in Canada were less than one third those of the United States after adjustment for size in terms of economic output. Industrial R and D expenditures in the United Kingdom after similar adjustment for size of the economy were more than double those of Canadian industry. In the United States and in the United Kingdom, industrial research was stimulated by World War I, while Canadian industrial research was not similarly stimulated until World War II. R and D in Canada has thus lagged about 20 years in comparison with the United States and the United Kingdom.

EXPENDITURES FOR RESEARCH IN CANADA

Table A

	1957		1958	
	Millions	%	Millions	%
Expenditures for research done within the company	$125.5	84.2	$133.6	83.0
Payments to others in Canada	3.8	2.5	27.4	17.0
Payments to others outside Canada	19.8	13.3		
Total	$149.1	100.0	$161.0	100.0

Fund Sources

The sources of funds for research done in 1957 **within reporting** companies are:

Table C **CANADA DOMINION GOVERNMENT FINANCING OF INDUSTRIAL RESEARCH AND DEVELOPMENT 1957**

Industry	Total Industrial Research and Development		Total Dominion Government Support of Research and Development in Industry		Dominion Government Support as per cent of Total Research Costs (by industry)
	$1,000	%	$1,000	%	%
TOTAL	149,144	100.00	61,646	100.00	41.33
Mining, Quarrying and Oil Wells	6,279	4.21	....	...	..
Manufacturing:					
Foods and Beverages	1,883	1.26	1	...	0.05
Rubber Products	4,308	2.89	111	0.18	4.31
Textile Products	1,482	0.99	....	...	..
Wood Products	148	0.10	....	...	..
Paper Products	6,213	4.17	....	...	..
Iron and Steel Products	4,340	2.91	16	0.03	**0.43**
Transportation Equipment	72,919	48.89	58,030	94.13	79.58
Non-ferrous Metal Products	5,793	3.88	40	0.06	0.69
Electrical Apparatus and Supplies	15,348	10.29	1,986	3.22	12.94
Non-Metallic Mineral Products	1,714	1.15	....	...	..
Products of Petroleum and Coal	7,489	5.02	....	...	..
Chemical Products	12,428	8.33	188	0.30	1.10
Other Manufacturing (1)	1,808	1.21	921	1.49	50.93
Transportation, Storage, Communication and Public Utility Operations	3,899	2.61	....	...	..
Other Non-Manufacturing (2)	3,092	2.07	351	0.57	11.36

(1) Includes Tobacco and Tobacco Products, Leather Products and Miscellaneous Manufacturing.
(2) Includes Construction, Health Services, Engineering and Scientific Services and Trade Associations.
Source: Based on data in "Industrial Research-Development Expenditures in Canada 1957," Dominion Bureau of Statistics, Ottawa, 1958.

- the federal government, which provided 49.1% of these funds,
- 39.5% through prime contracts and
- 9.6% through research parts of procurement contracts.

The reporting company itself provided 41.9% of the funds and parent affiliates 4.5% for a total of 46.4%. The remaining 4.5% came chiefly from companies not related to the reporting company.

Sources of funds for R and D not done within the reporting company are not available. Some of the funds are undoubtedly from government sources and are in the form of sub-contracts. If we assume that all research done outside the reporting companies was financed by the reporting company, then only 41% of industrial R and D was financed by the federal government.

In the U. S., government financing of industrial R and D has increased in importance from 36% in 1953 to 49% in 1956 of total industrial R and D funds or from $2.3 billion to $3.1 billion. This means that after adjustment for difference in size between Canada and United States the U. S. government provided from three to four times as much funds as the Canadian government for industrial R and D.

In the U. K. the government provided about two thirds of the £194 million spent on research by industry. In all three countries the governments are important sources of funds for R and D in industry. (See Table B).

The allocation of funds for industrial R and D is much influenced by the large defence support of research and development in Canada, the U. S. and the U. K.

In Canada, (see Table C) federal government support is concentrated (94%) in the transportation equipment industry (chiefly for aircraft). Electrical apparatus and supplies account for 3.2% of government support, or these two industries account for 97.2% of all government funds for R and D in industry. The transportation equipment industry accounts for 48.9% of research done by industry. Next largest is the electrical apparatus and supplies industry with 10.3%. The chemical products industry is the third largest performer in Canada.

In the U. S., federal funds for R and D are concentrated in the electrical equipment and aircraft parts industry. In 1956 more than 80% of U. S. federal funds went to these two industries. However, a number of other industries received substantial funds from the

Table B **SOURCES OF FUNDS FOR RESEARCH**

Source of Funds	Canada 1957		United States 1953		United States 1956		United Kingdom 1955-56	
	Millions*	%	Billions	%	Billions	%	Billions	%
Industry	$ 87.5	59	$2.3	63	$3.3	51	£65.5	34
Government	61.6	41	1.4	37	3.1	49	128.4	66
	$149.1	100	$3.7	100	$6.5	100	£193.9	100

*Including payments to others outside reporting companies.

Table D **INDUSTRY SIZE**

Industry size (Annual sales in 1957)	Number of firms	Total Research and Development cost $ Million	Percentage Distribution
$50 million and over	57	108.1	72.5
$10 million to $49 million	131	22.0	14.8
$1 million to $9 million	221	14.8	9.9
Under $1 million	46	4.2	2.8
	455	149.1	100.0

continued ▶

government. This means that R and D is assisted and encouraged in a wide range of industries even though this encouragement is in general toward research in the interest of defence.

In the U. K., the electrical engineering and aircraft industry, financed largely by the government for defence, account for 74% of industrial R and D expenditures. The high expenditures by the governments of Canada, U. S. and U. K. have tended to channel research into defence-oriented work. Encouragement of other industries which are not defence - oriented is equally important as the increased efficiency of a non-defence industry has a direct bearing on the resources which can be made available for defence work. If fewer resources in terms of manpower, capital equipment and raw material are required to meet civilian needs, more resources will be available to meet defence requirements.

Expenditures on industrial R and D for defence has an important lesson to teach in the role of the effect of government action on R and D. The air-to-air guided missile "Velvet Glove" began with four or five Defence Research Board employees, and grew in about five years to a group of 400 scientists and engineers of which the largest proportion (250 engineers) were employed by industry—and industry could take over further development.

This indicates the effect of a definite decision to do research and the result of its implementation.[1] Research teams in industry could be encouraged and developed for projects other than defence, such as in the long distance transmission of power, or finding of new uses for redundant resources.

Except for defence expenditures, our industrial R and D is done in industries where firms are few and large. Although governments finance most of the R and D in agriculture and to some extent mining, very little expenditure is devoted to research in those industries where firms are numerous and small. (Like textiles, clothing, services.)

The need for inventions or innovations based on R and D in industries which may otherwise stagnate is of the utmost importance. The importance of size in the undertaking or support of this work is illustrated in Table D.

Firms with sales of $50 million or over, representing only 2% of the 2,818 firms surveyed, made 72.5% of the expenditures on R and D. And remember, the government financed over 40% of this. Of the firms surveyed 1,364 had between 200 and 100 employees, only 124 of these reported R and D costs and these costs represented less than 6% of the total.

In the U. S., the large firms do most of the R and D. In 1953-1954, companies with 5,000 or more employees, or 2.4% of the companies doing R and D, did 72% of all industrial R and D. Small companies with between 8 and 99 employees made up 61.5% of those doing research but did only 4.3% of such research in the U. S.

A number of factors adversely effect growth of industrial research and development in Canada.[2] Canadian firms, particularly those providing for the domestic market, are apt to be small since the market is relatively small. As seen above, small firms do little research. The big firms are often diversified, producing a variety of products. These latter companies are in much the same position as the small firms, in that their economic activity is not exceptionally great in any one area.

Many firms are foreign-owned or controlled, and thus have ready access to research results of their parent company. They do not need to do research in Canada, although some of these firms have research facilities in Canada for the purpose of doing work on problems pertinent to their Canadian operations. Other companies, although not affiliated with foreign companies, find it most satisfactory to buy the plans and rights to use or make products developed abroad. In this way, they try to avoid the risk inherent in the research into and the development of new products.

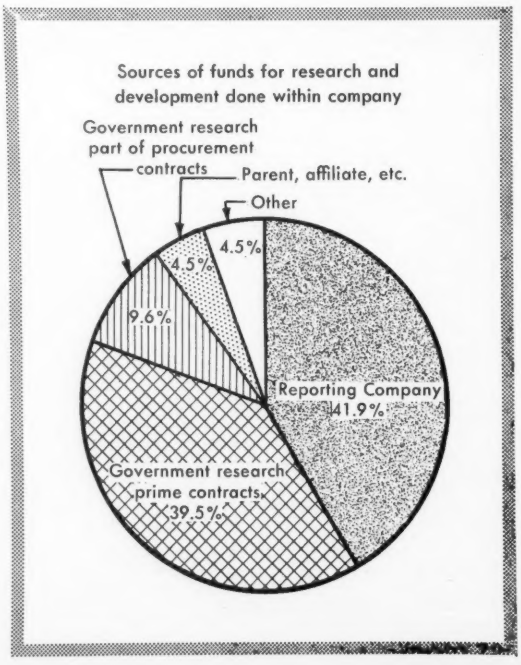
Out of all the mass of figures, percentages, calculations and predictions emerges one dominant fact. Expansion of industrial R and D in Canada is essential. But perhaps more than that—industry must underwrite this expansion, and get government support for projects of national interest.

Increased Research and Development by industry will assist Canada to improve its ability to compete in the now highly competitive world markets. And who can deny that this is one of our greatest needs? ★

[1] See Capt. D. J. Goodspeed, "A History of the Defence Research Board of Canada" Queen's Printer and Controller of Stationery, Ottawa, 1958, page 131.

[2] "Canadian Secondary Manufacturing Industry," D. H. Fullerton and H. A. Hampson, Royal Commission on Canada's Economic Prospects, Ottawa, 1957, page 131 ff.

Thanks are due G. T. McColm, B.A., M.A., Office of Economic Studies on Scientific Research and Development, NRC for valuable help in preparing this material.



Developing sawdust feed unit for a fuel log machine using cedar waste. Unit developed by B. C. Research Council.

The Provincial Research Councils

ONTARIO

The Ontario Research Foundation is not primarily concerned with pure theoretical research, but in the application of scientific thought and effort to solve the practical problems of industry. For this reason it has been called the "community workshop for Ontario's industry."

The main departments at the ORF are engineering, chemistry, metallurgy, biochemistry, textiles, mathematical statistics, physiography, parasitology and industrial research services. Since most of Ontario's industry is comprised of small manufacturing concerns (less than 50 hands) it can be seen that few manufacturers can afford R & D facilities of their own. Yet R & D is just as important to these small firms as to the larger companies.

At ORF these same companies can buy R & D in small packages to fit their budgets, and it is satisfying to note that many of them use these facilities constantly. It should be noted that ORF tries not to duplicate satisfactory testing resources available elsewhere, such as in commercial testing labs, universities, and so on.

The function of the foundation lends itself very well to the possibility of making available to all industry those machines and equipment which it would not be practical for any single industry to buy. As a result ORF has acquired such machines as an X-ray diffraction unit with X-ray spectrographic attachment, two types of infra-red spectrometers, an ultra-violet and visible light spectrometer with flame attachment, an unusually well-equipped metallurgical lab, a Losenhausenwerk metal-fatigue tester, and many other major pieces of equipment.

An important section of ORF is the department of Industrial Research services. This has a 10-man team, seven of whom are graduate engineers. The department's job is that of working with Ontario's smaller industries in an advisory capacity. Members of the department call on industry with technical information, sources, etc. Though advisory, the field representatives are retained from time to time and conduct research and development surveys. They help the industrialist to define his problem—and if he needs to have it resolved experimentally, tell him where to have the work done.

Obviously these liaison engineers are more familiar with the facilities of ORF—but when applicable they direct problems to other establishments. These include provincial and national government labs, private and academic research foundations, commercial labs, and consultants. Their primary function is to know where any particular type of technological service can be obtained—and to see that the client is well served.

Because the ORF is a non-profit organization, there is no temptation or desire to conduct an investigation

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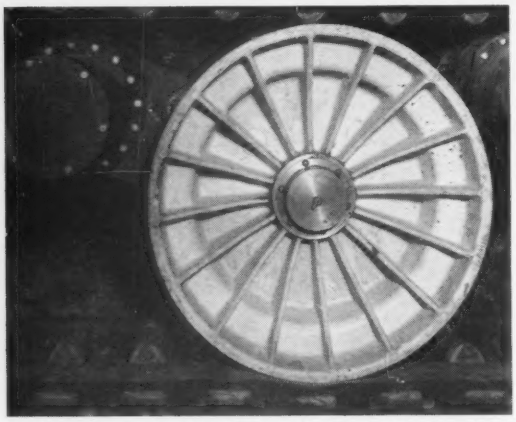


Ontario Research Foundation designed plastics wheel.

which does not appear to have reasonable merit. The foundation acts as the Ontario representative of the Technical Information Service of the National Research Council.

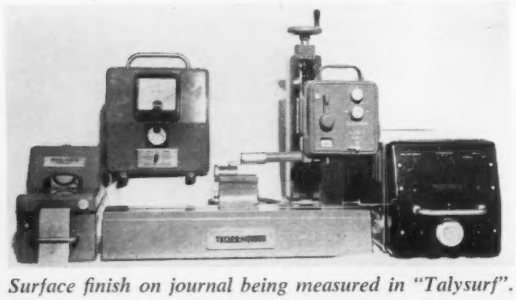
A financial responsibility of ORF is the disbursement of scholarships from grants made on behalf of the Department of Planning and Development of Ontario.

SASKATCHEWAN

The Saskatchewan Research Council was founded by an Act of the Legislative Assembly in 1947 and established in its present constitution by the Act of 1954.

In the latter year, the Council decided to supplement the university program it had undertaken in some of its functions by means of scholarships and grants to the University of Saskatchewan, by employing staff of its own, in its own laboratory facilities. This culminated in the opening of the Council's building in 1958 where research is conducted by engineering, chemistry, geology, information services and physics divisions.

The University and the Council have been investigating for several years the use of a flotation step in the recovery of uranium from the low grade ores of northern Saskatchewan. This work has reached the stage of a continuous pilot plant with a capacity of about 100 pounds per hour. Studies are being continued to correlate pilot plant and laboratory results.



Surface finish on journal being measured in "Talysurf".

To complement the above work, the engineering division undertook a study to determine approximate capital and operating costs of a number of processes that might be used to recover uranium from Saskatchewan ores. These studies indicate that under present conditions low-grade ores such as are being studied, cannot compete economically.

Low-temperature carbonization studies have been made on lignite coal from the Estevan area. The products of carbonization are char, a high grade fuel; tar and light oils. Yields were determined and an economic study was made to see whether the by-product tar and light oils would justify the carbonization step. Under present circumstances they would not.

A study of possible sources of raw materials suitable for the production of mineral wool has been completed. Samples of Regina clay gumbo, when blended with limestone were found to produce a good quality wool. An estimate of costs of a mineral wool plant located in Saskatchewan were made. This indicated a very high rate of return upon investment, assuming 50% of the prairie market could be captured.

The engineering division has taken over the work formerly conducted by the Industrial Minerals Research branch of the Saskatchewan Department of Mineral Resources. This consists of exploration for, and determination of, reserves of industrial minerals, primarily those which are raw materials for the ceramic industry. The division has a small exploratory drill and laboratory for ceramic testing.

The primary object of the information services division is to aid provincial industry, particularly in the solution of its technical problems. This is accomplished in several ways. Each industrial establishment is visited once annually in order to see their problems in physical form and discuss them with management. Problems may be answered during the visit or after consultation.

Second, industry is being kept aware of technological advances in its field, usually by letter, and by implementing and complementing the National Research Council's policy of "aggressive documentation." This second objective is also served by arranging meetings for visiting officials from various organizations.

Third, this division can advise the Council on industry's particular needs in research. Conversely, they can convey to industry an idea of the economic value of the Council's long term projects.

Last, because of their unique position in being aware of the technical problems of most of the provincial industries, it is felt that the division's consolidated annual opinion should be of iterest and value to the planning departments of many organizations.

ALBERTA

The industrial engineering services section made upwards of 1,000 calls during the year to various Alberta industries. This section serves as the field link for the National Research Council Technical Information Service. Assistance was also rendered to various government departments and internal council operations.

This section performs research and testing functions and stands available to provide increased service in matters requiring special engineering or chemical

investigation. Typical problems studied during the year included acoustics, wear, strength and fire tests on various materials. Studies of engine parts to determine causes of unusual wear and failure, and problems dealing with air and stream pollution were also investigated.

The council has a gasoline and oil-testing laboratory where routine testing and research on petroleum products are conducted. Both government and industry made increased use of these facilities during 1958.

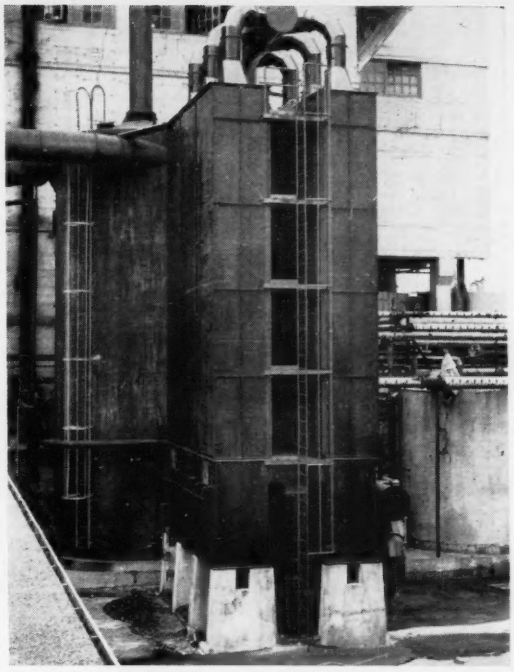
Basic research programs in coal and petroleum were aided during the year by the acquisition of an isotope ratio mass spectrometer and electron paramagnetic resonance equipment. Major effort of the highway research program was devoted to the instrumentation of a five-mile portion of the Trans-Canada highway west of Calgary in which test sections of three different types of concrete pavement were laid. Instrumentation was incorporated which will permit general tests and observations while test sections are under use.

Investigations in the petroleum section have been marked by an effective integration of engineering, geology, chemistry mathematics and microbiology.

High calibre staff additions coupled with extensive support of modern instrumentation have resulted in substantial progress.

The council also carried out extensive investigations in many other fields apart from engineering. The major groups being geological surveys and research, work on fossil fuels, soil surveys, co-operative work on basic cloud physics with reference to the hail problem. Basic and fundamental problems as well as strictly applied research are included in the fossil fuel investigations.

In summing up it can be said that 1958 has seen progress and development in all council programs of research.



Oxidation tower designed by B. C. Research Council.

BRITISH COLUMBIA

Industry in British Columbia is keyed to the production of primary products. Except in the forest and mining industries, manufacturing firms are generally small. Fewer opportunities exist then to assist in the design and development of new products than in an economy based on secondary industries.

However, the Council's design and testing facilities are essential and widely employed aids to industry. The B.C.R.C. has modern laboratories on the campus of the University of British Columbia. Founded as a non-profit organization in 1944, the Council now has a professional staff of 45; 22 have Ph.D degrees and 7 are professional engineers.

A recent survey estimated that expenditure on research and development by 200 of the largest companies in the Province last year totaled $4.5 million. Over $0.5 million was spent on research at the Council last year, and income from projects paid for by industry has increased threefold since 1954.

Most notable design achievement of the Council is an oxidation tower developed and designed for sulphate pulp mills. This design is used extensively in the Province and has received international recognition. The oxidation process affords one important control measure for combatting odours and yields improved sulphur recovery. In addition to installations operating in British Columbia, Alberta and Idaho, designs for plants in Mexico and Brazil are newly off the drawing board.

Other development work has centred on improving processes for the use of the province's main resource—wood. A process for making wood-gas, premium charcoal and liquid for derivatives from waste wood, employs a fluidized bed to effect a compact and efficient design.

Good markets for fuel logs have encouraged the design of a fuel log machine which uses waste cedar chips. Extensive knowledge of the behaviour of western red cedar under the influence of heat and pressure has helped develop a process both simpler and more elegant than the commercial processes currently used.

In recent years more manufacturers have been assisted with design and development. Besides chemical and food formulations (antifreeze, mop-oil and a sandwich spread, for example), the B.C.R.C. has helped in the development of circulating pumps, valves and a variety of house components. The Council is the western centre for approvals for Canadian Standards Association and Canadian Gas Association and these testing facilities provide a stimulus for local manufacturing design.

A wide range of high precision equipment, in the B.C.R.C.'s laboratories is regularly used by Vancouver's growing manufacturing industries. A small rotary kiln for expanding shale is used (for example) for the initial evaluation of the Province's shale deposits. The reports of two metallurgists on machine and metal failures were used to improve machine design.

Altogether, British Columbia's growing industries present many challenges for an integrated industrial research organization. The Council's fast developing facilities are well in step with this go-ahead province.

continued ▶

NOVA SCOTIA

The Foundation uses its funds to stimulate the utmost use of the available research facilities in the province. To this end, it co-operates with Provincial and Federal Government departments, industries, universities and organizations in the U.S.A.

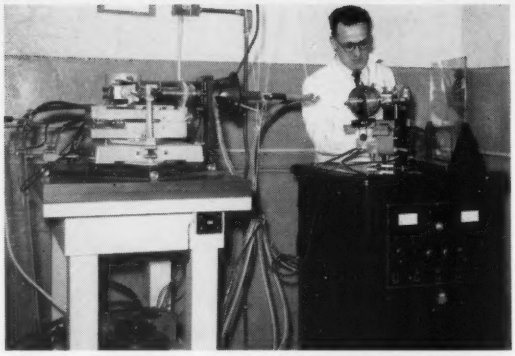
Some of its work has included the installation of new equipment and facilities in established laboratories and providing additional research workers. Instituting research grants and scholarships, particularly for summer projects, comes in this category.

The NSRF is responsible for keeping in touch with all phases of activity which might affect the provincial economy. Mining, agriculture, forestry, and fishing are its chief concerns.

A diversified program in various aspects of coal utilization is under way. It supports laboratory studies on the possibility of extracting the carbonaceous matter of coal by means of solvents to produce a liquid fuel. Research is sponsored on the mechanism of coal gasification and on the polymeric structure of coal. In co-operation with the Geological Survey of Canada, NSRF assists work on the identification and structure of coal seams. These are but a few of the many projects in hand.

By means of scholarships and grants, research in many aspects of the behavior of coal has been conducted at the Massachusetts Institute of Technology.

One of the most productive projects undertaken (in conjunction with the coal companies, the Provincial Department of Mines and the Ontario Research Foundation), is in the field of non-destructive testing. This has been concerned with the development of electronic equipment for the testing of mine haulage wire ropes while in actual operation.

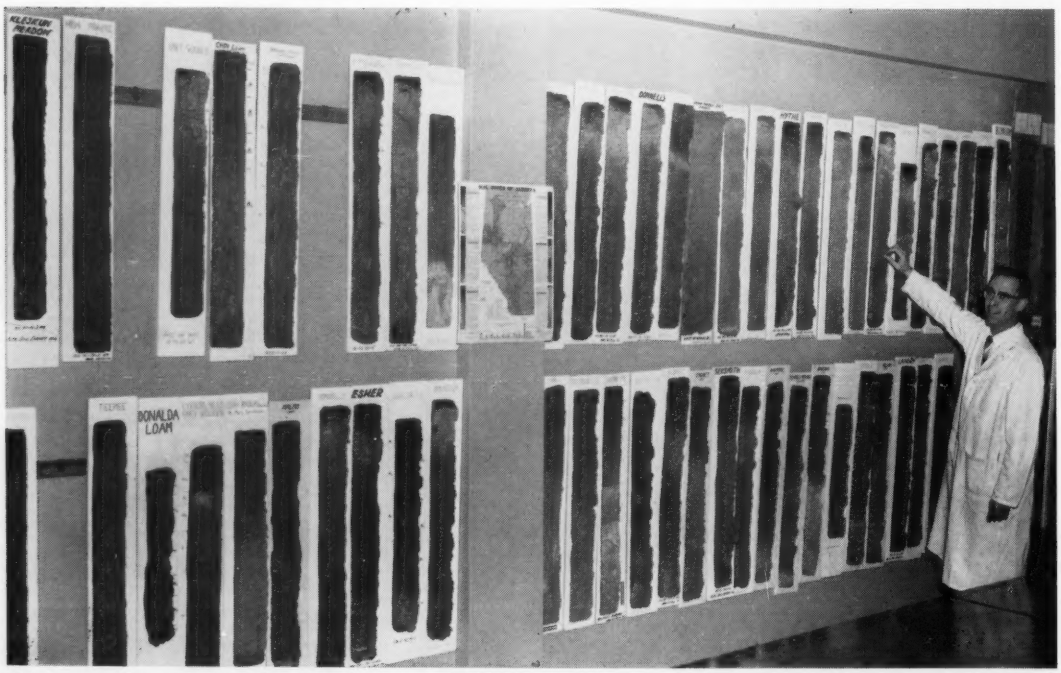


This goniometer is in labs of N. S. Technical College.

Local industries seeking new and extending present deposits of barytes, limestone, salt and gypsum, have been helped by NSRF's program of geophysical exploration. This research has shown that the deposits of salt in Nova Scotia are much more extensive than formerly believed, and there is a possibility that potash may be located in these formations.

To this end, the foundation has carried out gravity, magnetic, resistivity and seismic surveys over many areas of the province. These have led to a more detailed understanding of the underground structures in many areas.

Studies in forestry, agriculture and lakes and seas engage much of the foundation's attention as might be expected. Altogether, Halifax has become an important centre for scientific research in recent years. In support of this claim, the Chemical Institute of Canada chose the city to hold their 42nd Annual Conference. ★



Display profiles typical of the soils of Alberta. Much research is being carried out — like study of glacial till.

An aggressive R and D policy pays off

R. M. Cuddy, P.Eng.

There comes a time for every progressive company when management faces the question of a Product Research & Development program. Popularly known as R & D, it might be more accurately described, for smaller companies, as Product Development.

The basic and most powerful case for a development program in a small company is survival. Without a realistic appropriation from management, a company will go into a downhill phase, eventually. To sidestep the issue with stock excuses like "We can't afford it" or "Results take too long" is a poor substitute for a healthy-looking sales chart.

Even a properly integrated development program will not produce results overnight. But then it shouldn't be strait-jacketed into making such a claim. Unfortunately, too, it isn't possible to go to management and say "Give us X number of dollars and we'll give you the equivalent amount of R & D results." The costs are difficult to assess (this is confirmed by the National Research Council and similar organizations in the U. S. and U. K.) and the time taken for a project completion may have to be somewhat flexible. Other factors, such as possible technical obsolesence, may render a program useless overnight, and patent search revealing previous coverage may stop a project before it starts.

These, and other factors, are business hazards in the same way that no advertising or merchandising program can promise a specific increase in sales from a given number of advertising pages. But a realistic product development program does produce positive results. Take our own case for example.

About three years ago Beatty Bros. decided to set up a development group within the engineering department. Management realized that continual product modification wasn't the answer to holding and expanding existing markets. Original work had to be done under favorable conditions by a creative team of designers and technicians. The problem was formidable since our product lines are many and varied — appliances, pumping systems, farm lines, monorail and cranes, woodenware and contract work.

The first step taken to put emphasis behind this program, was to have engineering represented on the management committee. In this way all major company functions were co-ordinated, long-range development policies jointly arrived at, and engineering made aware that, important as development is, it must not be allowed to supersede either short-range planning or the day-to-day management of the business. Recognition of engineering and development activities as a major company function is a prime necessity, if the program is to bear fruit.

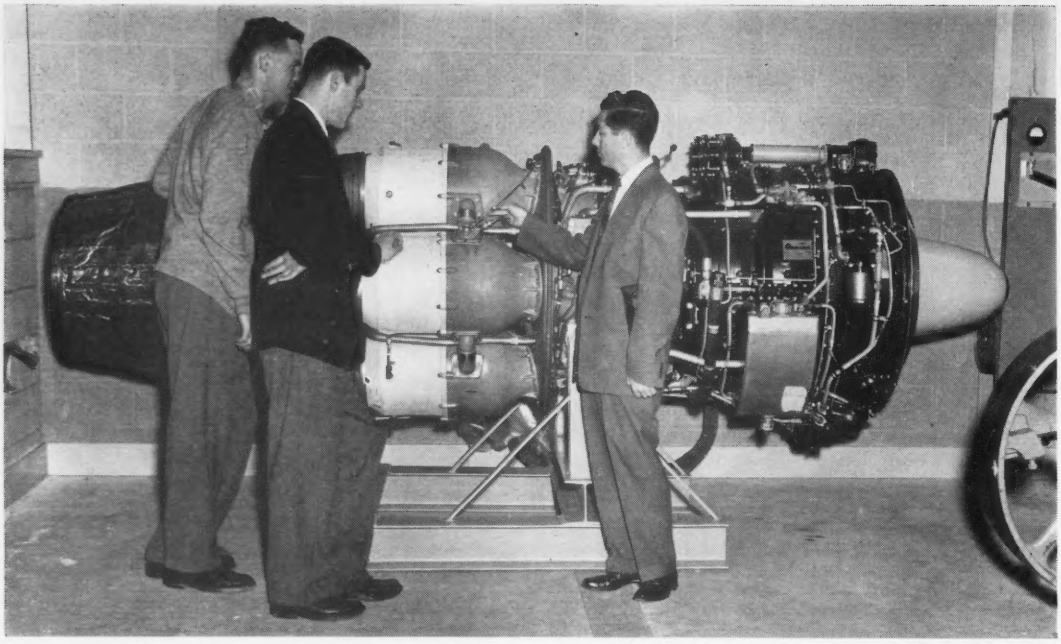
The next step was to reorganize the engineering department so that its activities could be co-ordinated with development. At that time the department consisted of a group of designers, a general drafting section, and a combined office and printing section. Both the design and drafting sections were regrouped in small independent design teams, one for each of our major product divisions, each comprising a supervising designer, a junior designer and one to five draftsmen according to the need. Each group is now responsible for complete engineering service relating to their product category. This consists of cost reduction activity, design changes and modifications for field or service needs, liaison with sales, service, manufacturing and quality control.

After this reorganization settled down, we created within our experimental department a separate, soundproofed (well, nearly!) room. This we called the Development Office. It was staffed with one of our best designers, a man of many years' successful development and design experience, as well as a designer hired from outside the company. A work area was created immediately outside the office and staffed with two of our best experimental mechanics. These men were assigned to development. This group was also assisted by our experimental supervisor, a man of many years experience with company products.

At this stage a general meeting of the engineering department was held and the purpose of the program outlined. Specific projects were set up and tentative target dates established.

Now, approximately one year later, we see that the results have been excellent. A major product innovation is close to completion, and several minor developments are showing considerable promise. We are now seriously considering expansion of the group — which is tangible proof of its worth.

We are convinced that many Canadian firms would profit by properly organized development activities and would find it of help in keeping ahead of competition. From our experience we would say that the principal requirements for a development unit to operate efficiently are: 1. management support through representation; 2. an engineering deartment organized to suit the needs of the company. 3. careful selection of personnel; 4. creation of an environment conducive to the job; 5. established targets and regular progress checks. ★



Topic is the "Orenda" jet engine: it's in the mechanical engineering lab. of the University of New Brunswick.

Research in the Canadian universities

Eric Haworth *Assistant Editor*

University of Saskatchewan

Perhaps the major problem facing the engineering schools in Canada today is the establishment of strong postgraduate courses and research programs. A necessary step in the evolution of the University of Saskatchewan's postgraduate school, is the formation of honor groups in the undergraduate school. It is not coincidental, for example, that in the past virtually all U of S students who have proceeded to higher degrees have been chemical engineers, engineering physicists, and geological engineers, i.e. honor graduates.

Postgraduate teaching and research are complementary and, in a University, it is almost impossible to divorce the two. Emphasis on planning new postgraduate courses which, for the most part, will be orientated in the directions of new fields of research will be made in the next year. It is hoped that these courses, combined with adequate research facilities, will attract postgraduate students from all parts of Canada and from abroad. Evidence of the salutary effects of the postgraduate students from other universities on the research groups with international reputations is abundant on the campus.

If further evidence is needed to show that a strong postgraduate school of engineering is essential, we have only to examine the statistics concerning the employment of engineers. There is a definite tendency for a greater percentage of men with Master's and Doctor's degrees to be required in industry. This is not surprising since a four year's course is becoming quite inadequate to train top-flight engineers.

The rapid growth of the student population in engineering, the research activities in the College during recent few years have been limited to 'ad hoc' problems, and the high reputation of the College has rested largely on the teaching programs. On the other hand, the research output of graduates in Chemical Engineering, Engineering Physics, and Geological Engineering has been impressive. Their contributions have materially helped the research programs of the Departments of Chemistry, Physics, and Geology.

Undoubtedly, engineering graduates will still be attracted in the future to research in these fields and perhaps the occasional physicist and chemist may transfer their allegiance to one or other of the engineering departments and this interchange will be encouraged.

New research programs will likely be grouped under three main headings:—

(i) Information processing and control systems.
(ii) Medical electronics and mechanics.
(iii) Operational research.

The aim is to set up strong research groups in each of these fields with the ultimate objective of perhaps establishing Research Institutes. The provisional planning of the programs has been considerably influenced by the requirements of the province, and by the favorable environment which this University provides. The choice of fields for special investigation has been encouraged recently by the strong financial backing which both federal and provincial agencies have provided for the program.

The work on information processing and control will be essentially inter-disciplinary and concern the Departments of Electrical Engineering, Mechanical Engineering and Chemical Engineering with, initially, a strong flavor of electronics. To be studied: ultra-high-speed electronic circuits for carrying out fundamental and logical numerical operations, which will push existing transistors and the ferrite materials to the very limits of their capabilities. These investigations will have, as a major aim, the development of extremely high-speed electronic computers which will probably, within the next ten years, be operating at speeds one hundred times greater than existing computers.

Research in the general field of medical electronics and mechanics is certainly already well established in the University.

It is thought that effective contributions can be made by engineers in fields involving sophisticated electronic instrumentation and high precision mechanical equipment. For example, many situations involving the measurement of minute electric fields are met. The correlation of the recorded data with certain physiological processes is becoming one of the key tools in these fields of research.

Operational research played a significant part in military operations during the last war and is playing an increasingly important role in industry and commerce today. The methodology of operational research is particularly well suited to a wide range of problems which will have an important bearing on the economic future of the Province. Operational research is an attractive field for the College because all departments of Engineering will become involved in one way or another.

Probably in collaboration with the Saskatchewan Research Council, U of S will have a not insignificant part to play in the scientific study of such important problems as the handling and transportation of grain, the irrigation of farm land, the optimum distribution of energy in one form or another to the rural areas.

University of New Brunswick

The capacity of physical plant about doubled during 1957-1958 by addition to the Engineering building. The 1958-1959 enrollment was 675, or slightly over 40% of the total number of undergraduates of U.N.B. The division of undergraduate registration is about as follows:

Civil Engineering	50%
Electrical Engineering	30%
Mechanical Engineering	20%

Graduate studies in Engineering are a relatively recent development at U.N.B. The first higher degree for a resident student was conferred in 1950. The number of graduate students is increasing sharply and by 1960, it is expected there will be twelve.

Curriculum changes have been frequent in recent years, with greater emphasis being given to basic science and mathematics. The trend in this direction is particularly noticeable in Electrical Engineering and, to a lesser degree, in Mechanical Engineering.

In the final year of Electrical Engineering, students must choose from a group of elective subjects. The purpose of this arrangement is to permit students of expectional ability to take up advanced courses which would better fit them for positions in research and development. These courses include computers, automatic control systems, circuit synthesis, switching circuits, solid state physics and transistor circuits. These electives are available in addition to a group of conventional courses which are required of all final year electrical students.

Other electives in the realms of management, finances and system operation may be chosen by students. Any of the electives may be chosen by any student but it is expected that only the better students will undertake the more mathematical subjects. Since only a limited number of these electives may be chosen by any one student, the others will be available as part of a graduate program.

U. N. B. staff are encouraged to obtain experience in the research and development area by spending their summers in research work either at the University or in Government research laboratories. Some members of the staff are taking sabbatical leave for the purpose of advanced studies and research at other Universities. At U. N. B., research support from both the National Research Council and the Defence Research Board is enjoyed.

Projects which are either current or to be undertaken shortly include work in pre-stressed concrete, the stresses in machine elements, automatic control systems and both analog and digital computer circuitry. A study of the effects of freezing and thawing upon concrete has been in progress for several years.

Recently acquired major items of equipment which will assist in the stimulation of advanced work include a new compression testing machine, a fully instrumented gas turbine, an electronic analog computer and a small ac network analyzer. Plans are well advanced for the addition of a stored program digital computer during the next year. The number and quality of the instruments and apparatus which are basic to the development of a research program has been increasing rapidly in recent years. It is reasonable to predict that there will be considerable growth in this direction in the immediate future.

Some engineering faculties even have radar equipment.

continued ▶

University of Manitoba

Department of Mechanical Engineering

Graduate courses were first offered during the 1957-58 session. The M. Sc. course consists of a "major" in mechanical engineering and a "minor" in mathematics with emphasis on thesis projects. The major is comprised of two courses, heat transfer and gas dynamics, both including problems and design projects.

Thesis projects have been centred around convective heat transfer, the most interesting of which is an attempt to establish convective heat transfer coefficients for helical finned tube arrangement. This work is closely related to work which has been carried out in the United Kingdom in support of their gas-cooled reactor development. The data on the subject is sparse and if it can be correlated, a continuation of this project would take the form of tests with varied helical tube configurations. To correlate the results requires establishing parameters which can be used universally. This project is being supported by the National Research Council, but this is on an annual grant basis, and if research is to grow in Canadian Universities, further continuous support is required.

From Manitoba's point of view, support in the form of a fund from which staff members could draw to cover the cost of model test work and technician assistance would be sufficient to sustain research. Research carried out at a University should be fundamental and as such could serve to consolidate empirical design methods developed by industry or to provide industry with information required for development programs. In general, contract research is neither desirable nor possible, although no objection could be raised to the sponsors specifying the field and outlining their interest in the field.

Department of Electrical Engineering

During the past three years graduate student enrollment leading to the M. Sc. degree has increased severalfold in this department. The most presently active research is in the field of circuit-theory, and two special analogue computers have been designed and built, under sponsorship of the National Research Council. The facilities of a Bendix G-15 digital computer, donated to the University by the Pioneer Electric Co., Winnipeg, are also available.

Courses are offered in control system design, electronics, transistors, antennas and propagation, circuit theory, synthesis, materials of electrical engineering.

In the power field, courses exist in power systems and in high voltage technology. At present, one student research project is the design and construction of a modest "network analyzer", to be used primarily for teaching, but capable of reasonable accuracy and having considerable flexibility for a variety of problems.

A number of the Department staff at present spend the summers at the University, actively engaged in directing graduate student research. Development in the research field depends entirely on the complementary factors of staff interest and monetary support. Unfortunately significant consistent organized support from industry (with a few notable exceptions) is almost entirely lacking. It is suggested that direct and substantial grants from industry in aid of research in specific fields, to be used by the University department concerned as it sees fit, would be, in the long run, a most remunerative investment.

It is firmly believed that a large part of the benefit to the graduate student lies in the thesis and its associated research. Adequate staff supervision of thesis projects requires a great deal of time and effort. With increasing numbers of students, pressures arise, tending to reduce or even eliminate the thesis requirement. It is to be hoped that sufficient support for graduate research can be obtained to ensure the continuation and even the strengthening of the research approach.

McGill University

During the past year, engineering education has received more attention and attracted more discussion than at any other time.

The enrolment of undergraduate students in the faculty was 1813, compared with 1709 in 1956-57. Of this total, 136 were registered in architecture, and 83 were registered in the "advanced" options or courses. In addition 48 graduate students were pursuing their studies in the various departments.

In the past decade graduate study and research has steadily developed in the Faculty, but its growth has been hindered by numerous factors. No strong traditions existed in this field; staff have been overloaded with undergraduate teaching during the session; in general, most of the staff have found it necessary to supplement their salaries by outside work in the summer; during the prosperous times the financial value of graduate work was unrecognized by most of the better students; little space was available; and financial aid to meet the heavy expense of experimental work in engineering was usually only available to those already established. In spite of these difficulties, much has been done. (See table for picture of the present position.)

This represents a considerable graduate effort in spite of the difficulties. In view of all the things that are happening, considerable increase is expected in the graduate study field.

Beside undergraduate teaching work, members of the staff have much else to occupy their time. Counselling students, directing graduate students, and research, obviously are part of what might be termed regular university work. In addition, however, they do much that reflects credit on the Faculty. Staff from every department are concerned with committees of profes-

ENGINEERING STUDENTS
McGILL — 1958-59

Department	Undergraduates in last two years	Students Reg'd M.Eng.	Ph.D.	Total graduates
Chemical	82	0	5	5
Civil	135	7	1	8
Electrical	150	10	0	10
Mechanical	133	15	5	20
Metallurgical ..	17	3	0	3
Mining	16	2	0	2
Total	**533**	**37**	**11**	**48**

sional societies, and of both Federal and Provincial government departments. Some of the staff members also practice their profession. In most cases the experience so gained is of value to them and their students, and frequently suggests problems for graduate study.

Last summer about 3,000 ft. of additional laboratory space for the Department of Civil Engineering and two new classrooms were built. With this extra space it was possible to accommodate the increased enrolment.

The year is noteworthy for the graduation of the first two students to complete the Mechanical Sciences Option in the Department of Mechanical Engineering. This course was initiated two years ago as a "de facto" if not "de jure" honours course. The curriculum is both quicker and more rigorous than the regular course and, like the other advanced options in the faculty, can only be entered upon by those showing considerable mathematical capacity.

The outlook for the future is promising. Present stature is considerable and to combine with the factors that have maintained this position in the face of past difficulties, there are now several favorable factors. A new building is now under way; in spite of all the financial difficulties the Board of Governors has found it possible to increase salaries considerably; there is at least a hope that some solution to the constitutional problems that prevent McGill from enjoying the support of the Canadian people is in sight; there is the fact that more students will be seeking admission, giving more talent to choose from; and lastly, there is a more general awareness among the public that the education of engineers and scientists is of considerable national importance. With all this in mind we should consider the objective.

In common with all the other Canadian universities, the work of this faculty has been concentrated primarily on the undergraduate student. While this was undoubtedly correct in an earlier period of Canada's industrial development, such a policy is incorrect today. The need for well trained and creative engineers as expressed by Canadian industry today, and those which will be found in the future, can only be satisfied by the development of an active graduate school. It is essential moreover, that the universities should not be afraid to lead industry.

At the present stage of development it is improbable that there can be much real improvement in the undergraduate school without the development of an active graduate school and research tradition.

Q.E.C.V.I.

At Queen Elizabeth Collegiate and Vocational Institute in Kingston, Ont., experimental classes in pre-engineering are being conducted. In September of 1958 the pre-engineering classes became complete from Grades IX to XII. In this course, one studies all the necessary academic subjects, and a graduate of the course is fully qualified to enter Grade XIII.

The differences between the pre-engineering course and the regular academic course are:

(1) the pre-engineers take only one foreign language, usually, French,
(2) extra work in physics, chemistry and mathematics is encouraged,
(3) the pre-engineering classes take some special technical subjects, in addition to the standard academic work. In Grades XI and XII the technical work includes drafting, surveying, electricity, electronics, and machine shop.

Corner of workshop—Q.E.V.I. pre-engineering course.

Each pre-engineering grade has a special feature. In September of 1959 the Grade IX class will begin study of astronomy, the Grade X class geology and the Grade XI class special work on the cathode ray oscilloscope. The Grade XI class are also required to submit a project illustrating some phase of physics. Some examples of projects already completed are a solar furnace, and a model of an atomic submarine.

The Grade XII class take tours of local industries and must hand in a written report on one of these industries. They must also prepare and lead a classroom discussion on a scientific topic of their own choosing. Some of the talks and discussions this year have been on space satellites, meteorology, jet engines, atomic submarines, the sun and the solar system. The students are urged to develop information for their talks and projects as much as possible on their own.

Since its inception in 1955, the staff feel that the course has given its graduates a sound base for University training in the engineering and scientific fields.

(Contributed by Jim Kelly—
a student in T12X at Q.E.C.V.I.)

McMaster University

McMaster University offers courses in all branches of engineering except mining. These are based on a strong foundation of fundamental science and mathematics—strong enough to allow emphasis of the aspects of design and research in engineering.

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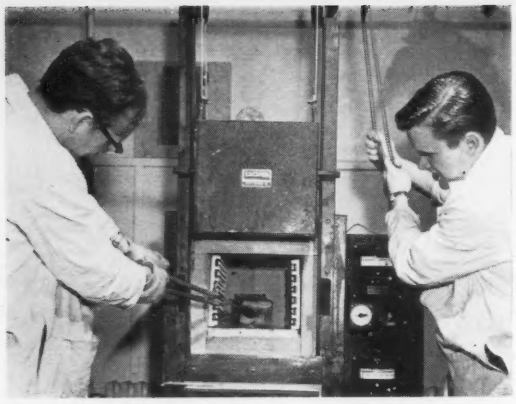


Metallurgical grads working on carburizing operation.

The curriculum has a high content of mathematics, physics, and chemistry, along with as much of the humanities as can be accommodated. Because the course is "heavy," the admission requirements are set at the level of 64% average out of Grade 13. This has resulted in the gratifying high degree of success by first year students—the most severe time of trial in their education. The student is required to be master of a foreign language (other than English) before he enrolls, and required to take at least one further course (French, German or Russian) while at university. Ninety students are taking the course at present, and the university is prepared to enroll up to 150 students in September, 1959.

One of the requirements of the staff being assembled is an interest in original investigation. Graduate research work is essential to the health of the modern faculty. Otherwise the university will be following technological trends, whereas in some areas at least, it should be pointing the way. The engineering school, therefore, must be a place where engineering is being performed as well as taught.

All branches of engineering dealt with are taught in a single building. The laboratories are all located in the wings and the nonlaboratory functions—the lecture rooms, drawing rooms, offices, and machine shops are in the central area. The total floor area is about 185,000 square feet, of which research occupies about 30,000 square feet.

The facilities for chemical engineering include eleven research laboratories. McMaster has for some time been interested in the employment of sonic energy to create turbulence at interfaces and this is receiving thorough attention.

Sonic vibrational energy is being investigated as a means of increasing local interfacial turbulence, superimposed upon the flow of the light material past the dense one. This research has been very sporadic, since a hiatus was created by the university's building program, but some principles and generalities are beginning to appear which recommend its continuance as a research program. Many other research programs in chemical engineering are in their incipient stages.

In the Department of Mechanical Engineering, work is proceeding on the mechanics of the flow of two or more layers of liquid of different densities. Such flow occurs at the mouths of rivers flowing into the sea, where temperature gradients are extreme, or where water carrying sediment flows into clear water. The position and stability of the interface may be important, and the whole flow pattern is of interest. Thin jets such as those occuring at the headbox of a paper machine will be the second study, to be started at an early date.

The machine design section is planning to initiate a study of an unusual articulate vehicle for traversing of rough terrain. The idea to be followed on this problem is so extreme that the section is reluctant in describing it any further until they examine its feasibility in more detail.

Dr. Oravas, who is the sole professor in the Department of Civil Engineering and Engineering Mechanics, is an expert in the design and the analysis of the stress conditions in thin shells. His experimental program is supported by the National Research Council.

The Department of Metallurgy and Metallurgical Engineering has been established longer than the other departments, and its research programs divide into two fairly clear-cut categories: solid state physics, and the study of the thermodynamics of irreversible processes as they apply to metallurgy.

These then, are some of the highlights of the present status in the McMaster Faculty of Engineering. Although so many of the plans are embryonic, it is refreshing to realize that as the university put it—"we are logging some progress toward what we feel is a most exciting target—an engineering school which is appropriate to our position in space and time."

University of B. C.

There has been a threefold increase since 1953 in the number of engineering students undertaking graduate work at Canadian universities where a total of over 500 graduate students are at present registered. Some 80 of these are enrolled in the engineering faculty of the University of British Columbia. Six of the graduate students at U.B.C. are proceeding toward the Ph.D. degree.

Research work undertaken by staff and students has been financed by grants from the National Research Council, the Defense Research Board and industry.

In March 1957 the University installed an ALWAC II-E magnetic drum digital computer. This computer is being used increasingly by staff and graduate students.

U.B.C. top brass setting program for digital computer

Some of the research projects being undertaken in the various engineering departments at U.B.C. are described below:

Civil Engineering

1. Studies of navigational improvements on the Fraser River estuary.
2. Large water displacements in the simple surge tank.
3. Study of the use of the tellurometer in geodetic surveying.
4. Deflection theory of arches.
5. Programming the digital computer for determination of economic use of water in hydro-electric plants.
6. Passage of young fish through turbines.
7. Effect of local buckling on torsional stiffness of thin-walled sections.

Mechanical Engineering

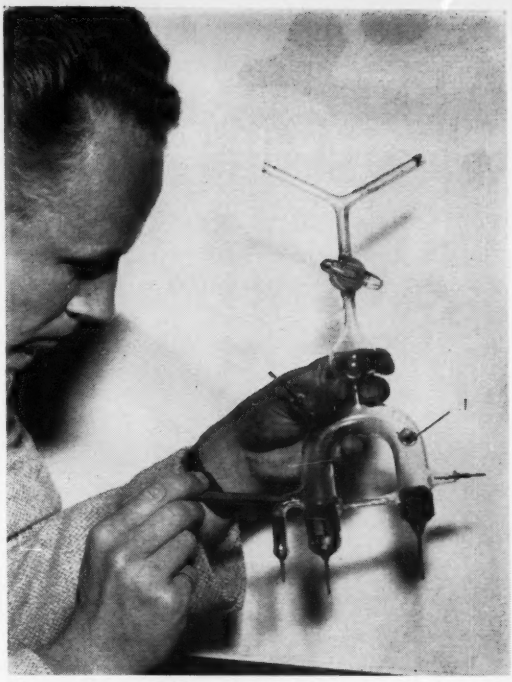
1. Applied mechanics: investigation of gear tooth dynamic loads. Study of the influence of surface finish on the wear of steel surfaces under boundary lubrication conditions. High speed lubrication.
2. Heat transfer: heat flow through building materials during heating and cooling cycles.
3. Aerodynamics: an investigation of the aeroelastic instability of two-dimensial bluff bodies.
4. Fluid mechanics: a new solution for two-dimensional potential elbow flow.

Chemical Engineering

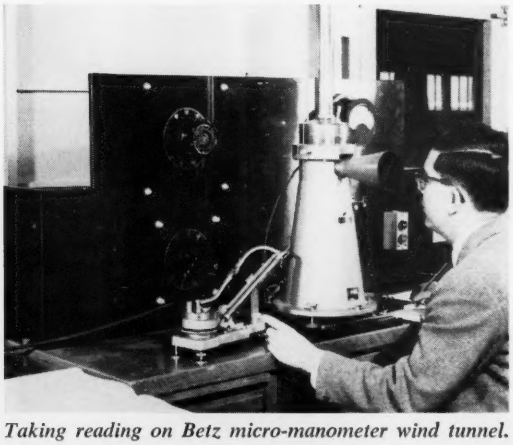
1. Mass transfer in liquid—solid systems; multi-component distillation.
2. Vapor-liquid equilibrium in multi-component systems; thermo-dynamic properties of mixtures; corrosion studies; studies of Canadian crude oils; transport properties of fluids.
3. Heat transfer in rough pipes; momentum, heat and mass transfer in beds of stacked spheres; heat transfer outside rod bundles; void fraction studies of random loose packed beds; liquid-liquid extraction by spouting.
4. Absorption of oxygen in sulphate process black liquor and sodium sulphite solutions.

Mining and Metallurgy

1. Primary refining of aluminum-20% silicon; a study of the effect of dispersed-phase, consisting of a precipitate formed by the artificial nucleation of a supersaturated liquid solution of aluminum-silicon on the variation of mechanical properties as a function of the mean free path of solid solution matrix, or alternatively of inter-particle silicon spacing in an aluminum-20% silicon alloy. Includes study of interaction between factors causing primary refinement and those causing eutectic refinement.
2. Mechanical effects of grain boundaries during plastic deformation: to study the propagation of slip lines through crystal boundaries, in high purity aluminum.
3. Transformation in Zr-Nb and Zr-Nb-Ti alloys: a continuation of the work by Finlayson and Whitmore in these laboratories, this project comprises the establishment of isothermal transformation diagrams for Zr-16% Nb-5% Ti and Zr-15% Nb-Ti.
4. Quenched-in lattice defects: to measure the energy of formation and the activation energy of migration of quenched-in lattice defects in silver, and to study the effects of alloying elements in dilute solution in the silver.
5. Metallic whiskers: the preparation and examination of metal whiskers, initially to study yield stress and creep as a function of temperature.
6. Properties of Ceramic-metal bonds: to study the mechanisms of bond formation between metals and single crystals of pure ceramic materials.
7. The occurrence of measurable amounts of radioactive materials in plants: to investigate the extent and identity of radioactive materials in British Columbia plants.
8. Acid-dependence of the solubility of atomic in water: to determine whether the solubility of atomic mercury in water is dependent on acidity, as predicted by J. Halpern.



Mercury-arc switching tube used in electronics research.



Taking reading on Betz micro-manometer wind tunnel.

Electrical Engineering

1. Circuits and antennas at very high frequencies: to develop a new form of wave-guide ferrite circulator; a new form of strip-line ferrite circulator; a multimode waveguide filter.
2. Computer programs for network synthesis: to establish a library of programs for the Alwac III-E

continued ▶

computer covering the routine procedures of network synthesis.

3. Synthesis of filter groups: to determine the feasibility of the design of filter groups by the insertion-loss method.
4. A sonic and ultrasonic sweep generator: to develop an instrument for displaying system functions over the sonic and ultrasonic range.
5. Reading machines for the blind: to evaluate the possibilities of print reading machines using tactile, or electrical or audible stimulation.
6. Variable torque induction motors: to design and construct an induction motor without slip rings or commutator for variable speed and torque.
   Torque and speed control of induction motors using saturable reactors: a general analysis of the possibilities of saturable reactor control of induction motors.
7. The application of the digital computer to power system engineering: to systematize the design of extra high voltage power-system.
8. Noise and oscillations in gas discharges: to obtain a fuller understanding of the mechanism producing noise and oscillations in gaseous discharges.

University of Toronto

One hundred and eighty-three graduate students are carrying on research in one or other of the departments of the Faculty of Applied Science and Engineering of the University of Toronto toward the M.A.Sc. or Ph.D. degree.

Such research has three important functions: (1) it is an end in itself, i.e., the results are valuable; (2) it provides the environment in which alone a first-class staff can develop and have its full impact upon the student; and (3) it provides the best means for developing the student's individual thought, effort and enterprise in his chosen field. This approach is the key factor in graduate work, and one which develops the essential creative traits in students acquiring post-graduate experience.

Electrical Engineering

Investigations are being carried out in feedback control systems where there is an increasing demand in industry for graduates having experience in this field. This study includes signal representation, systems with multivariable inputs and outputs, and man-machine systems. In the field of power modulators, improved designs are being studied principally through the use of better magnetic materials that have recently been made available. Interesting applications of frequency multipliers to induction motor speed control have been developed.

Theoretical and experimental work on antennas and antenna radiation is leading to a better understanding of the properties of antennas and their radiation patterns. This work, particularly as applied to airborne antennas, is of especial significance in the area of national defence. Studies of the properties of wave guides are also being carried on; and, finally, the Astronomy Department and the Electrical Engineering Department by means of a radio telescope set up at Richmond Hill in 1936 are engaged in a joint research project on radio astronomy in a new and promising field.

Well-equipped labs like this make teaching job easier.

Metallurgical Engineering

Problems in extractive or chemical metallurgy research are concerned with the production of metal, and the thermodynamic properties of metals and alloys. For example, considerable attention is given to the production and purification of metals (e.g. magnesium) by distillation, and research is in progress to determine the factors which control sintering in various iron ores. Lack of thermodynamic data for metal systems retards development, and so the determination of activity coefficients and other data on several light metal alloy systems, such as the niobium-oxygen system and the ternary iron, chromium, carbon system are under way.

Another program is concerned with the effect of solutes and imperfections on substructure formation during solidification and the effect of these substructures on the strength of metals, with the production of controlled structure castings and the development of high strength materials in mind. Much research is being done on the properties of very high purity metals produced by the relatively new technique of zone melting and the zone purification.

The Institute of Aerophysics

A division in this Faculty, is studying plasmas associated with guided missiles and space craft. A plasma is an extremely hot gas with a high degree of dissociation and ionization. The fact that it reacts with magnetic fields opens up a whole new area of gas dynamics with applications to flight.

The Institute has a magnetically driven shock tube capable of temperatures up to 1,000,000 F. A shock wind tunnel for hypersonic investigations at speeds up to thirty times the speed of sound is under construction. A free molecule tunnel for the study of the flow of

highly rarified gases at supersonic and hypersonic speeds (the first of its kind) has been in operation for five years. A plasma tunnel, capable of simulating the flight conditions for satellites and space craft, has been designed and preliminary tests are in progress.

In the field of practical aerodynamics, the Institute is actively engaged in studies of vertical take-off and its application to Canadian requirements. Investigations are also well advanced in the aerodynamic noise of modern aircraft, and a new project has just been initiated on the fatigue of aircraft materials.

Mechanical Engineering

Work on a plasma generator, directed toward extra-terrestrial propulsion applications and high intensity thermal shock study is being pursued, involving temperatures in excess of 26,000 F. Heat transfer is being studied, using electrical and gaseous flow analogous to steady- and transient-state three dimensional heat-flow problems. Solar energy application studies have been continued.

In the machine design field, the problem of balancing multi-mass flexible shaft systems to reduce whirling is under investigation. Photo-elastic methods of stress analysis are being used to solve a number of problems, such as the determination of stress wave fronts due to impact loading, propagation of the elastic-plastic boundary as load is increased, and a study of multiple-layer beams. Recently, work has been completed on the effects of the elastic-constant changes during stress freezing, and on stress concentration factors for multiple perforations in sheets and beams. An investigation of the system characteristics of a non-polarized null-seeking servo-system is also in progress.

In the fluid flow laboratories studies of spillway discharge characteristics, energy dissipation, canal lining stability, "Hurricane Hazel" hydrology, wave generation and erosion control have been pursued. Other studies involve open channel roughness, flow configuration in nuclear reactor core assembly, centrifugal separation of particle suspensions, aerodynamic downwash from chimney stacks, diffusion of gaseous plumes, and dynamic operation of intake gates.

A variety of research problems is under way in Civil Engineering in fields such as soil mechanics and foundations, structural engineering ("An Analytical Study of a Three-Span Continuous Concrete Slab Bridge"), surveying ("Geoidal Contours"), hydrology, and highways research ("The Design of Interchanges").

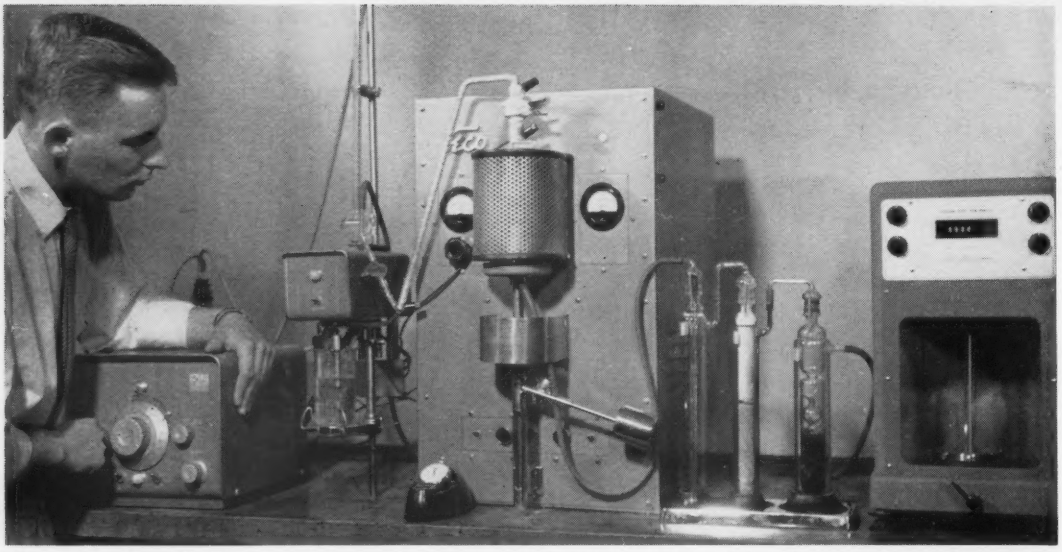
Analogous projects are also under study in Chemical Engineering.

This Faculty has for many years carried on a graduate program that has increased in magnitude with the passage of time — though not as yet to the extent desirable for Canada's potential needs.

Conclusion

Canadian universities are thoroughly research conscious and most of the ones included in this report have their own research programs under way. The NRC and large industrial organizations underwrite much of the university research. But there is a growing feeling that "medium to small" companies should contribute to this vital work. Deans of many engineering faculties insist that their teaching staffs have strong learnings toward research — a most encouraging sign. ★

The engineering sciences are no longer for men only as this photo, taken in an engineering faculty lab, shows.



Photograph shows high-frequency combustion furnace being used in making sulphur determination in research lab.

Research in Canada's nickel industry

G. S. Farnham, Ph.D.

Intensive research and development activity is required to minimize the impact of general rising costs. This is also necessary to meet the stern competition of products which may be substituted for those in which companies supporting research and development work are directly interested.

A major problem to those responsible for research program has been to determine the amount of money that may be spent justifiably. In the U. S. 1½% of the Gross National Product goes to research and development but expenditure by industries in terms of the sales dollar varies from 7% for concerns producing pharmaceuticals, to 4% for chemical producers, and to 1% for iron and steel construction groups. However, "percentage of sales" is not considered to be a satisfactory measure of effort.

When there is no change in product, savings effected by research can be calculated. The calculation of savings made, however, is much more difficult when a new product or a new development of an old product is involved. In process work it is a problem to budget costs, as the percentage of expenditures going to pilot plant operation is high and difficult to predict. Budget requirements can be estimated more accurately in product research, even more so for fundamental work.

Returns from research and development activities are intangible as well as direct. But new and improved products and processes are essential for industrial expansion, and research to produce these is becoming the basis of economic survival.

Tradition has glorified the individual research worker. The present trend, however, is to employ group effort in attacking research problems. One difficult decision is "How much research time should be devoted to basic problems?" Moreover, what may be considered basic by one organization would not be so regarded by another concern.

The universities and government laboratories are logical places for basic research activities — but industry has a major interest, as the results obtained eventually should be put to practical use. Furthermore, more basic research is needed than universities can afford or than governments, so far, have seen fit to do. Industry does give direct support to university work, but in many cases there are reasons to justify companies carrying out a considerable part of a basic research project. For instance, the services of outstanding men sometimes can be obtained by allowing them some time for basic research work. Also, some employees, while able, are not temperamentally suited to applied research work.

Aspects of Process Research

A difficult problem involved in process research, is to determine the scale of the pilot design. It is usual to go from laboratory work, where grams of materials are handled, to miniplant operations where feed is measured in pounds, to pilot plant efforts where material is handled by the ton. When practical, the size of the final plant should not be more than twenty-five times the size of the pilot plant.

In process research, it is usually best to have research activities close to the operating plant. Care must be taken, however, that the research staff concentrates on processes of the future rather than on maintenance research of processes in operation. This latter consideration also applies to product research where the development staff should be engaged primarily on new projects rather than on technical service work.

Personnel for new plants is usually provided by flow of staff from research laboratories to miniplant to pilot plant to full-scale operation. This, of course,

necessitates the recruiting of new research personnel who bring with them new ideas.

In the Canadian economy, production of raw materials occupies the dominating position. In this regard, the output of the mining and metallurgical groups is important.

Up to the end of the First World War, nickel, as a result of Scotman Riley's 1889 experiments on nickel steel, had been used mainly for military purposes. As a consequence there was no demand for the element in the early twenties, and the mines of the Sudbury district were closed. Despite this, in 1922 the International Nickel Company management decided to embark on a full-scale development and research program, to expand the peace-time uses of nickel. The effort was most successful. By 1929 more nickel was being used in industry than was consumed in the peak period of the First World War. The program led to the development of new uses, and a nucleus of men skilled in the arts of making, servicing and selling nickel-containing alloys.

Research in the physical metallurgy field was part of the original program, and continues to be most actively pressed. This work involves fundamental studies using all available modern tools. Results obtained in the research laboratories and in testing in the field have led to the gathering of what is probably the world's broadest knowledge of corrosion processes.

New Discoveries

Great advances have been made in the development of alloys and welding rods which allow for the ready production of high quality weldments. Special alloys with outstanding electrical magnetic and expansion properties also have been created. Mechanical properties at low, normal and high temperatures of cast iron, nonferrous alloys and steels, have been improved through the addition of nickel. New applications of nickel-containing stainless steels have been developed. A new metallurgical product, ductile iron, was discovered in one of the International Nickel Company's Research Laboratories. Electroplating of nickel has been intensively studied and the applications of nickel-plated parts actively promoted.

The first commercial air-borne magnetometer survey, testing its use over the known ore occurrences of the Sudbury basin, was made. As a result, highly sensitive air-borne electronic devices for selecting magnetic anomalies more favorable for detailed investigation by nickel seeking ground parties, were perfected. The ore body located, geological research took over from there.

A continuous program of study and explorations has produced many important developments in mining equipment and techniques. This has made possible the more economical handling of lower grade ore bodies, and in turn directly led to an increase in usable ore reserves.

The nickel industry has perhaps made its most outstanding contributions in the development of metallurgical processes for the successful treatment of lower grade ores. These process improvements have led to greater efficiency of operation, with the result that 14 elements are now being economically extracted from the ores of the Sudbury Basin.

Other conspicuous improvements were the matte separation process and the introduction of oxygen flash smelting of copper concentrates.

Research Pays Off

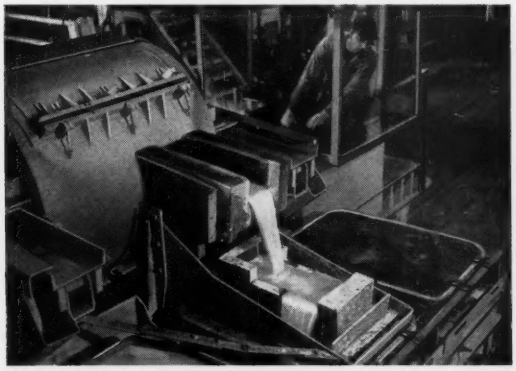
Until recently, the iron in the Sudbury ores was eliminated in slag which had no commercial value. Ten years of research, however, has led to the production of an iron ore, second in grade to none in the world. The removal of this iron from the nickel smelting circuit, through flotation of a nickel-bearing iron sulphide concentrate, has automatically increased the capacity of the nickel reverberatory furnaces.

Improvements have also been achieved in nickel refining operations. In 1942 a change was made from a straight sulphate to a sulphate-chloride electrolyte. This not only improved the economy of operation, but also led to the separation of cobalt — an element first marketed as an oxide and later as a high-purity electrolytic cobalt. Very recently electrolytic production of nickel has been initiated by means of a process in which nickel matte rather than impure nickel is employed as the anode. Interestingly, one of the products of this process is elemental sulphur, which is separated from selenium, also present in the anode slimes, by a filtration and distillation process.

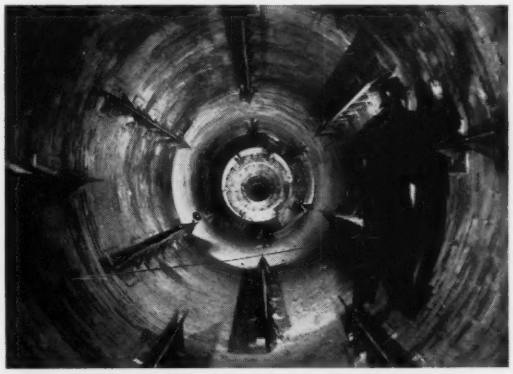
In 1952, Professor Forward of the University of British Columbia and the Sherritt-Gordon Mines Limited, culminated a long research program with the development of a pressure ammonia leaching process involving the extraction of metallic values from nickel-copper sulphide concentrates.

In reviewing the achievements of the nickel industry, it is apparent that well-planned and executed industrial research plays a vital role not only in the utilization but also in the exploration of scientific knowledge, and is therefore a significant positive factor in developing the wealth and welfare of Canada. ★

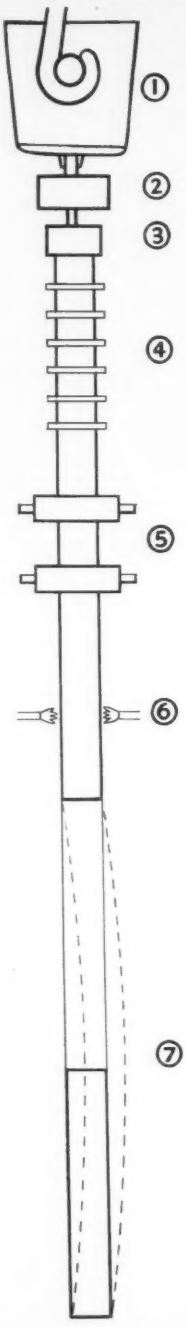
Dr. Farnham is asst. mgr. for Canadian Research and Development—International Nickel Co. of Canada Ltd.



The semi-automatic anode casting machine in operation.

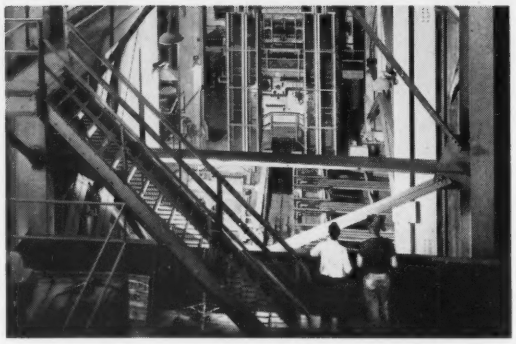


This rotary kiln is 185 ft long and 13 ft in diameter.



CONTINUOUS CASTING

1. Ladle filled with molten steel from electric furnace is transported to top of machine. Molten steel flows from bottom of ladle into tundish
2. which traps slag and controls flow of steel into water-cooled mold.
3. Molten steel solidifies around bolts embedded in dummy bar positioned in mold. Dummy bar carries steel into mold, and steel passes through water spray chamber
4. which helps solidify steel: pinch rolls
5. is next movement. Steel enters cutting chamber
6. where oxyacetylene torches cut slab into the desired length — 7.



Part of continuous casting machine at Atlas Steel. Process helped company reduce steel prices by 15 to 20%.

Experience proves the value of Research and Development

W. B. F. Mackay, Ph.D.

Research and development has been an important aspect in the company's progress over the past 30 years. In 1928 when Atlas started operations producing a limited range of tool and alloy steels with a labor force of only 35 men, research and development existed but was definitely more visionary than scientific. Nevertheless, the basic philosophy of success through progress existed then and formed the nucleus for present R & D programs within the company.

Today, our research and development embraces the following fields: basic research, new and improved products, new and improved processes, and market projects.

Basic Research

The program is largely carried out at established research foundations in Canada and elsewhere. It includes research work conducted at the Department of Mines in Ottawa where the company has assigned staff to observe and assist in the work. In contrast, most development work is conducted within company boundaries and under immediate and direct control. Naturally, this basic research is largely confined to studying steelmaking from a metallurgical viewpoint. This knowledge is of vital interest in the devising of original and superior steels as well as in improving of process techniques, particularly in the melting and casting of specialty steels and alloys.

Process Research

Process research is aimed at improving existing steelmaking techniques as well as exploration of new

processes that can be adapted to our particular manufacturing requirements. Currently vacuum degassing and vacuum melting techniques are being studied in relation to their adaptability to our steelmaking needs.

Examples of items which have been studied and carried through to operational status are our Continuous Casting Machine and Hot Planetary Strip Mill which are, we believe, the first of their kind to operate commercially in North America. The basic installation costs of such equipment are not included in R & D costs as these units are financed as capital equipment, once research has indicated that they have practical possibilities. However, once in operation some further research and development is conducted to expand their operational scope.

Continuous casting has proven the effectiveness of R and D. In April of this year selling prices of No. 1 finish types 302, 304 and 316 Atlas stainless steel sheet were reduced by 15 to 20%. These price reductions were a direct result of the company's continuous casting process which was installed and pioneered at a cost of over $1 million. After several years of operation, much of it involving costly research and development, this process is now an integral part of production.

The continuous casting machine bypasses the conventional ingot mold stage in steelmaking. It permits steels to be cast into slab directly from the melting stage and provides higher yields of usable steel per ton melted. In addition, preliminary heavy rolling processes are reduced. Thus the early production stages for No. 1 finish stainless steel sheet are more efficient and the savings achieved are now being passed on to Canadian industry.

No. 1 finish stainless steel sheet has a variety of end uses throughout industry and the pulp and paper, chemical and petroleum industries are among the principal users.

The hot planetary mill, stage one in the production of 18-in. wide coiled stainless steel strip became a regular part of the company's manufacturing facilities after thorough investigation and research. In this unit, stainless steel slabs are heated to 2250 F, pass through reducing rolls and emerge as coiled strip ready for finishing operations. In a single pass through the mill the slab thickness is reduced approximately 95% or from 2½ in. to ⅛ in. This transformation from cold slab to hot strip takes place in only 14 minutes.

Product Research

This is the second general category covered by our R & D program and involves the development of new compositions or grades of steel as well as new forms, shapes, and finishes.

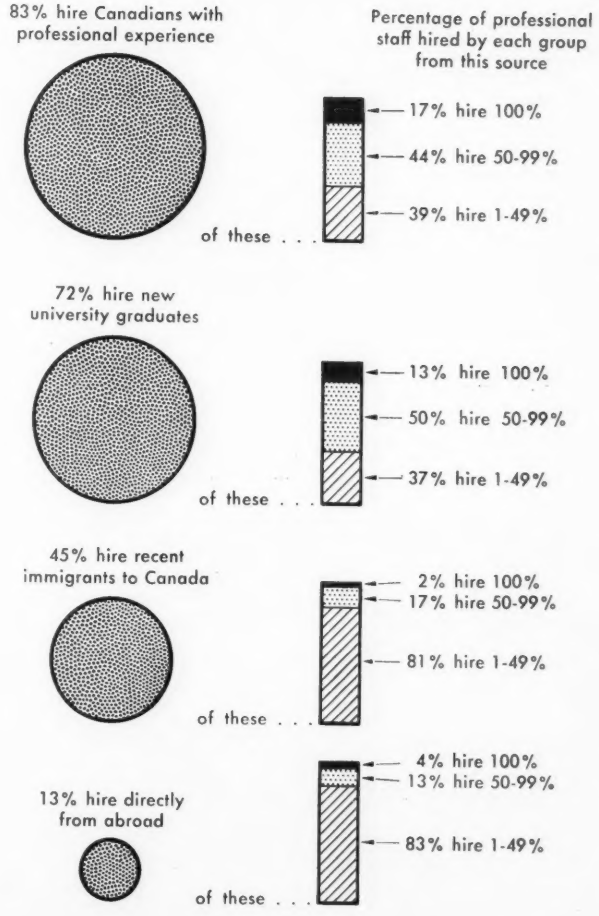
Last year, 25 specific research and development projects were in progress.

The effectiveness of the company's R and D is readily borne out in 1957 reports which stated that "we now make twenty-five per cent more standard tool grades than we did four years ago." In 1956 with thirty-one projects under way, R and D launched several other programs.

Activities of the company's R and D specialists periodically move into areas of product development. Recently for example, their services were employed in projects which included stainless steel being used in a standard line of bathroom wall tile, as well as in the development of textured finish stainless steels for architectural applications.

The company's R and D program can best be summed up as follows: the ceaseless pursuit and creation of new and improved specialty steels to better serve the diverse needs of all industry in this country. ★

Where most Canadian employers meet their demands for engineers


83% hire Canadians with professional experience
Percentage of professional staff hired by each group from this source
of these . . .
17% hire 100%
44% hire 50-99%
39% hire 1-49%
72% hire new university graduates
of these . . .
13% hire 100%
50% hire 50-99%
37% hire 1-49%
45% hire recent immigrants to Canada
of these . . .
2% hire 100%
17% hire 50-99%
81% hire 1-49%
13% hire directly from abroad
of these . . .
4% hire 100%
13% hire 50-99%
83% hire 1-49%

Some student aid programs in Canada

Many programs exist in Canada for student-aid and post-graduate research. This article is intended as a sampler of the field, rather than a detailed report on all of them.

Here's help for the budding engineer

Open purse strings is the order with many Canadian companies in underwriting pre- and postgraduate scholarships — especially for research

In 1954, Ford of Canada established a plan to provide university scholarships for the sons and daughters of employees. So far, 31 young men and women have been given the opportunity to attend Canadian universities and obtain higher education at no cost to themselves or to their parents.

The plan is being extended, and up to five scholarships will be available for competition among students now in their graduating year in secondary schools. These scholarships cover the full cost of university tuition and academic fees, as well as a major part of the living expenses of the student while attending university. The scholarship winners may choose any approved college or university in Canada.

To be eligible to compete for a scholarship, the applicant must be the son or daughter of a company employee below the rank of general foreman or equivalent, and such parent have continuous service since January 1, 1957. Provision is also made in the plan for children of persons who died while in the service of the company, and for sons and daughters of employees on lay-off who have recall rights.

The winners of scholarships are chosen by a selection board, on the basis not only of academic records, but of the personal qualifications of the applicant.

Promoting academic research

Northern Electric has established a new three-part student aid program for graduate and undergraduate students at Canadian Universities.

Altogether, six graduate research fellowships, valued at $1,500 each, have been granted to McGill University and Ecole Polytechnique in Montreal, Queen's University, Kingston, and the Universities of Toronto, Manitoba, and British Columbia. The purpose of these fellowships is to promote and encourage academic research in such fields as electrical, mechanical, chemical or metallurgical engineering, engineering physics, or physics.

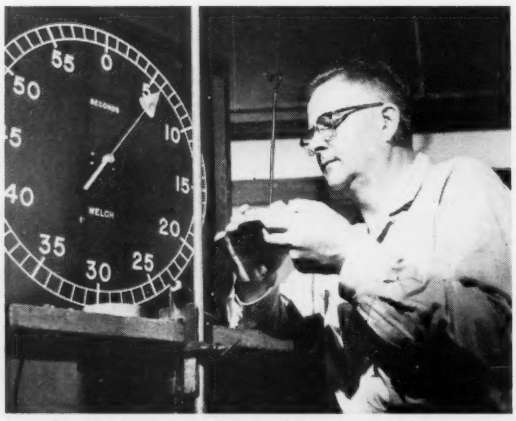
Sixteen undergraduate scholarships and eight Employee Bursaries, valued up to $500 each, will be offered at universities throughout Canada.

Of the 16 scholarships, 13 will be offered for the promotion of undergraduate study in engineering (electrical or mechanical), engineering physics, engineering and business, mathematics and physics or pure physics. They will be available at a number of Canadian universities.

Fellowships and scholarships will be granted to candidates selected by the universities concerned. Generally speaking, the only conditions imposed by the company are that the recipients shall be Canadian citizens, British subjects, or landed immigrants in Canada. Candidates for fellowships, of course, must be graduates of a recognized university.

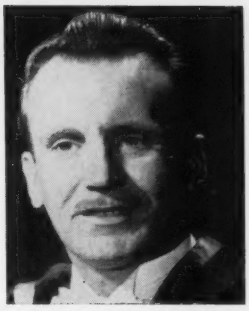
Both undergraduate scholarships and bursaries are to be used for tuition, laboratory and incidental fees, and books. All awards cover one academic year and will be payable through the university attended by the candidates.

Geo. Walker, maths teacher of Kentville, N.S. (right) was a 1958 Shell Merit Fellow: electron measurer shown.



Woodstock physics teacher Neil Runnalls using Atwood's machine to calculate acceleration due to gravity (Cornell).

George F. Atkinson (left) and Miss Sylvia Freddi both recipients of 1958 Union Carbide scholarships. Atkinson attends University of Toronto and Miss Freddi, McGill.



J. D. Raal (Toronto U) and W. M. Hawkins (McGill U) benefited under the fellowship program. Raal is working on liquid extraction, Hawkins on economic geology.

Lion's share to universities

Imperial Oil made its first grant to education in the mid-'20s. Since then, its contributions have multiplied dozens of times.

Today this company spends hundreds of thousands of dollars a year to help raise education standards in Canada. Most of the money goes for capital grants to universities (in 1957, the company contributed to 31 institutions of higher education). In addition, the company operates an extensive university scholarship and fellowship program and makes grants-in-aid to Canadian universities attended by scholarship holders and fellows. Monies are donated each year to universities for specified research projects. While universities absorb the lion's share of its corporate gifts, primary and secondary institutions benefit through Imperial's sponsorship of teachers' exchange bursaries and through donations — $100,000, to be spread over the five years 1957 to 1961 — to the Canadian Education Association.

In recognition of the importance of research in the fields of liberal arts and the humanities, Imperial tries to maintain a correct balance in awarding its graduate fellowships. At present, fellowship holders are studying such subjects as rational psychology, the history of Canadian banking, and the social history of eighteenth century England as well as a broad range of subjects in the scientific fields.

A fellow receives $1,250 a year for three years and an additional $750 per summer if he studies in the summer months. Though he can study at any recognized university in the world, most have chosen to attend British institutions. Since 1946 the company has spent more than $157,000 on this fellowship program. Undergraduate scholarships, open only to the children and wards of employees, have cost $316,000 since they were initiated 12 years ago.

Small companies make grants too

In order to encourage the scholastic aspirations of children of employees of the company, Crouse-Hinds Company of Canada Limited has established one University scholarship tenable for a maximum period of four years. It will be made annually to candidates who have shown their aptitude to receive higher education.

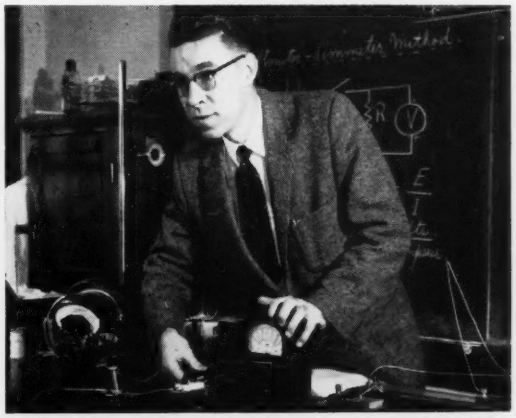
The company scholarships are open to children and proven wards of employees who intend to enter a regular course in any recognized Canadian university. Preference will be given for electrical, mechanical or metallurgical engineering and business administration and studies related to business administration.

Each of the awards will cover the cost of three or four years tuition as the case may be in the course of study chosen by the successful candidate, and approved by the Scholarship Committee, up to a maximum of $550 per year per scholarship.

No strings attached

Union Carbide Scholarships and Fellowships totaling approximately $50,000 have been awarded this aca-

Women rate too. Miss Eva Jagoe, Calgary maths teacher qualified for a seminar at Stanford U. Palo Alto, Calif.



One of five Western Canada teachers attending Stanford U seminar was Ernest Ziolowski, Regina, Sask.

continued ▶

demic year to 64 university students as an aid to their education, and to support fundamental research. As science and engineering are the two most popular courses being studied by these Scholars and Fellows, the awards will assist in supplying the country's need for trained researchers and engineers.

Sixty students received undergraduate scholarships valued at $500 a year, and four were awarded post-graduate research fellowships at $1,500 a year. These grants are sponsored by Union Carbide Canada Limited, although the selection of recipients and administration of the plan is left entirely under the jurisdiction of the universities.

The 16 students studying engineering, and the 29 enrolled in science make these two subjects the most popular among the scholarship winners. Under this scholarship plan, the students each receive $500 a year for the duration of their academic course.

This company's research fellowship program, sponsored at McGill University and University of Toronto, is open to graduates of Canadian universities who have demonstrated distinct evidence of ability to conduct original research. The four fellowships are tenable in either the natural or social sciences, and have a basic value of $1,500 a year. This year's research fellows are working toward their Ph.D. degrees in analytical chemistry, chemical engineering, geology and sociology.

Started five years ago, the scholarships are open to any graduate of a secondary school who has good scholastic standing and personal reputation, and who intends to enter business or industry. Applications may be made directly to any of the 19 participating universities, who select the candidates and who administer the plan.

This company also has established a program of capital grants to university funds. The assistance applies to degree-granting institutions which are members of the National Conference of Canadian Universities.

As a matter of interest, the company's total program of financial and education (scholarships, fellowships and capital grants) for the period 1954 through wider planned expenditures in 1959, will approach $400,000.

Teachers qualify for grants

Shell Oil Company's interest in Canadian education is provided in two general forms. Financial assistance to universities and other institutes of learning, through building fund drives, etc., and direct aid to university students and others through scholarships and fellowships.

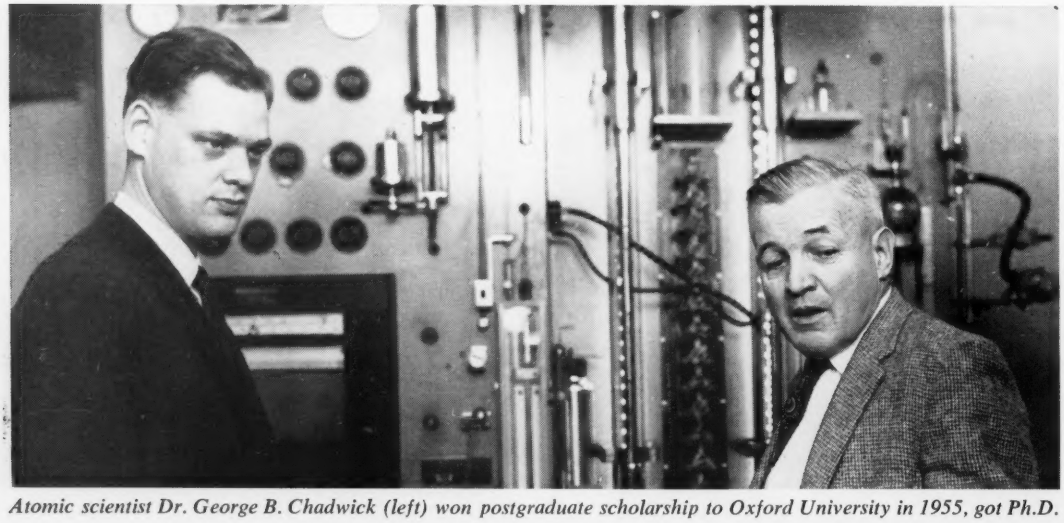
The extent of the company's financial support to Canadian universities, exclusive of scholarship and fellowship costs, may be gauged from the fact that the company is currently pledged to total contributions of more than $150,000 in this field. In 1958 alone, approximately $50,000 was paid to educational institutions.

Since the end of the Second World War, the company has provided a number of postgraduate fellowships in the field of science and engineering to students of selected universities. Each fellowship is valued at a maximum of $1,800 and is accompanied by an unrestricted grant-in-aid of $500 which is paid to the university to defray the expenses of administration and teaching which the fellowship entails. The number of fellowships awarded annually was increased to its present total of eight, in 1954.

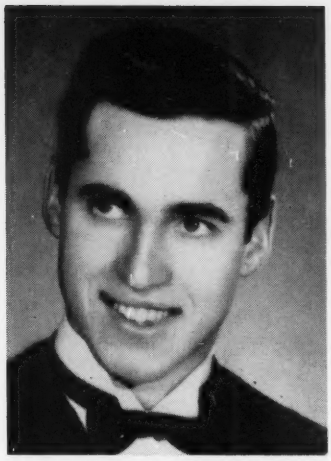
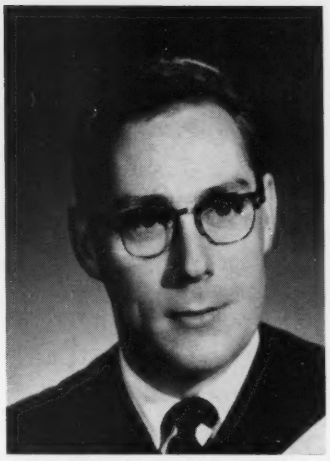
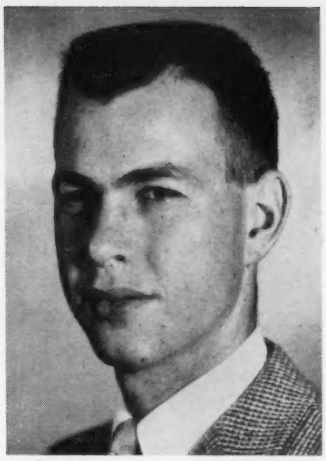
A second major development in the company's program of aid to education occurred in 1957 with the inauguration of Shell Merit Fellowships for secondary school teachers of science and mathematics. In its first year, the program provided a total of six Shell merit fellowships for special summer seminars at Cornell and Stanford Universities. In 1958, the total was increased to 10, five at each of the two universities.

More awards each year

The number of C.I.L. fellowships available to Canadian university students for post-graduate chemical research has been increased to 18 for the academic year 1959-60.



Atomic scientist Dr. George B. Chadwick (left) won postgraduate scholarship to Oxford University in 1955, got Ph.D.

Some C.I.L. Fellowship winners, R. J. Cushley (left) is studying for his M.Sc. in chemistry at U of Alberta; J. L. Patenaude for Ph.D. in chemistry at U of Montreal, and D. J. Whittle (right) chemical engineering Ph.D., UBC

This total includes a new fellowship worth $2,400 annually, of which $2,000 will be awarded to a qualified post-graduate student seeking a Ph.D. degree in chemistry at the University of New Brunswick.

There are now 16 such fellowships for doctoral studies at various Canadian universities. Two other fellowships, for students working toward master's degrees are valued at $1,500 each. For all 18 fellowships, the universities alone select the recipients, assist them in choosing topics for study — and direct their research throughout the year.

Since the program was inaugurated in 1940, the value of each fellowship and the total number of awards has increased steadily. This company's grants have included university research in chemistry, chemical engineering, agricultural chemistry and metallurgy. Grants for extensive post-graduate studies in wild-life management are also in their fifth consecutive year.

Postgraduate research

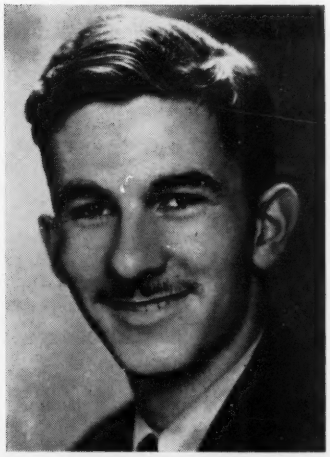
Altogether 13 Canadian universities and colleges participate in the Graduate Research Fellowships underwritten by The Consolidated Mining and Smelting Company of Canada.

Each fellowship (one to each university) is valued at $1,500 and is normally valid for one academic year. To be eligible, an applicant must be a graduate in science, engineering or agriculture of a recognized university, and a Canadian citizen or other British subject resident in Canada.

The university authorities concerned shall be responsible for appointing the fellow, and shall select the applicant who, in their judgment, is most suitable.

The subject of each research investigation to be carried out under the Cominco fellowships shall be in some field of pure or applied science, preferably related to the mining, metallurgical or chemical industry. Subject of the forthcoming year's work is notified to the company by the university authority concerned. This allows Cominco to turn over to the university any special knowledge it may possess.

Since the fellowships were instituted in 1944-5 119 individuals have been helped in their post-graduate studies. ★



Also studying toward Ph.D. degrees are C. Brian Cragg at McMaster U, Catharine F. Haggart at McGill ("reactions of active nitrogen" is her thesis), and at U of Saskatchewan another fellowship winner is K. A. H. Adams.

Iroquois lock on the St. Lawrence Seaway. Thousands of engineers were needed on this major Canadian/U. S. job.

The need for keeping track of engineering personnel in Canada

J. P. Francis, B.Comm.

Have you ever wondered how your career as an engineer compares with other members of your graduating class? What kind of work are they doing and is it in Canada? Like you, the Department of Labour is vitally interested in these questions.

It is when such questions are raised to the national level, however, that they become fundamentally important. Engineers are one of the key groups of manpower on which the nation's economic growth depends, and it is essential that something be known about what happens to these manpower resources.

The whole issue of how our engineering manpower resources are being utilized, needs to be examined from a dynamic rather than static point of view. Answers to questions like: "What kinds of careers are being followed by our engineers?" . . . "Who employs engineers?" . . . "How are their needs for such highly trained people changing?" . . . Answers to these and other such questions are vitally important.

To get them, the Department of Labour is developing a program to record as much information as possible about the careers followed by those who become qualified as engineers.

Establishing a system

First, we are concerned with the sources from which additions to our engineering manpower resources come. They consist of the graduates each year from engineering courses in our universities and colleges; people who become qualified by passing the examinations set by the respective engineering associations; Canadian students who obtain engineering degrees in foreign universities and then return to Canada. Included, too, are professionally qualified engineers immigrating to Canada each year. We are developing procedures to obtain information on the annual contribution of each of these sources of supply.

Second, the size of the group must be studied. We are interested in the career of each individual from the time that he becomes professionally qualified to the time that permanent withdrawal from the labor force or the country takes place. There are many thousands of such individuals in Canada, and the problem of keeping in touch with them each year would be formidable.

Our solution consists of dividing the whole group into three equal parts and surveying one part each year. This means that the size of the survey required each year is within practical limits and that each in-

There is no substitute for qualified engineering personnel. In background is stiff-legged derrick in lock gates.

dividual is only asked to complete a questionnaire and return it to us once every three years. Since the division of the whole group into three parts is done on a stratified (by year of graduation and field of study) random sampling basis, the findings of each year's survey are representative, within known limits, of the situation for the whole group.

Third, because engineers, particularly in the years immediately following graduation, move about geographically, we must keep their addresses up to date. Here we rely heavily on the help of the various professional associations. An additional number of other special devices are being developed to reduce this problem.

In summary, then, we have a main survey which is undertaken each year and covers a representative one third of everyone who has become qualified as a professional engineer. Around this main survey there exists a constellation of smaller investigations whose purpose is to obtain the necessary information on additions to these resources. This, very briefly, is the program we have under way.

The job pattern

It is less than two years since we began the very complicated task of making this research program operational. Now, we are at the stage where survey and analysis procedures are in effect, but some "debugging" has to be done. One year from now we expect that the program will be producing a full range of facts on the careers followed by engineers and scientists. Even now, however, we have some information of this sort which we would like to mention. It should be remembered that the examples which follow are intended to be suggestive of what can be accomplished, rather than show fully the results of our work.

One of the questions many engineering students ask is — "What are my chances of finding a technically challenging research job when I graduate?"

We can say in answer to that, our findings to date show that less than 10% of all those in Canada with an engineering education were doing research work in 1957. In that year, and the pattern would not likely change rapidly, more engineers were in administrative, management and executive work than in any other kind. Production and construction was the next most important work in numerical terms.

The types of jobs which engineers hold change significantly as experience increases. For engineers with 10 years or less of experience, production and construction jobs are by far the most important type of work obtained, with one of every three in positions of this kind. About half as many are in junior supervisory positions and an additional one third are in designing work.

As experience increases, there is a very marked shift away from production jobs into administrative and executive positions. There is also an important increase in the number of engineers doing consulting work. The proportion in designing jobs drops markedly as, of course, does the number in production work.

We were somewhat surprised to find that a greater proportion of the young and relatively inexperienced engineers reported that they were in research and development jobs than did the older experienced personnel. In part this is due to the recent growth of research activities in industry, but it also seems that many of the research jobs engaging recent graduates are not too complex and that career opportunities for the person who stays with this type of work are, by and large, relatively limited. This latter point becomes clear when the earnings of these people are examined in relation to others with the same amount of experience but in different kind of positions. Median earnings for those in research jobs are relatively low despite the fact that many of these people have postgraduate education.

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It must be pointed out that research work is increasing and will undoubtedly offer better career opportunities as its importance grows.

From a future manpower-resources point of view, one of our important findings has been that very few engineering graduates go into teaching jobs. In 1957 only one per cent of all of the engineers who had obtained a bachelor degree, and no more in the preceding 10 years, were in teaching jobs. The proportion of those who had secured a postgraduate degree in the same period and gone into teaching was higher — 13% — but it was disturbing to note that this percentage was lower for recent years than for those who had graduated more than 10 years ago.

Findings and predictions

In general, our findings indicate that the earnings of engineers increase quite rapidly during the first dozen years of experience, then less rapidly until a plateau is reached after about 20 years of experience. Subsequently, the trend of earnings is erratic with some tendency for declines to occur for those who are still working full-time after 35 to 40 years of experience.

Until a way is found of providing a path to higher earnings which does not entail a shift into different lines of work, the problem of obtaining top-notch people for teaching and research work will persist.

Finally, we would like to comment, in terms of our findings, on the probable requirements for engineers over the next decade or so. What is the employment outlook for engineers over the next five to ten years?

Any evaluation of future job prospects for engineers must be based on a knowledge of who employs them and what kind of positions they fill. Basically, the engineering employment outlook depends on the growth potentialities of those industries which employ engineers in the largest numbers, and upon any trends in these industries which would make the functions performed by engineers more or less important.

Although there are probably very few industries in which at least one or two engineers are not working, it is nevertheless a fact that the major employers of engineers are mining companies, manufacturing firms, construction contractors and public utilities, including transportation and communication companies. A sizable number of engineers also find jobs in all three levels of government and in an increasing number of engineering consultant firms.

Now it is very significant that the recent exhaustive survey of Canada's economic future, carried out by the Royal Commission on Canada's Economic Prospects, found that most of these industries which we have just mentioned are among those expected to be the fastest growing ones over the next two decades. In no case is their rate of growth expected to be significantly less than average. We can conclude, therefore, that the industries which employ most of our engineers are also those with the best future growth possibilities.

What about the kind of work performed by engineers? Apart from the growth of the industries referred to previously, can we expect the demand for the services which engineers perform to increase even more rapidly? We think the answer to this question is an unqualified yes. In today's world, economic growth is becoming more and more dependent on the practical use in the factory, and in the business office, of as many as possible of the latest scientific discoveries. This is exactly the task of the engineer and the technician, and means that needs for these kinds of highly trained people lead the way to our future economic development.

It would appear that future employment prospects for engineers in Canada are good. Not only are industries which employ most of them expected to be fast growing ones in the future, but also the needs of these industries for people with an engineering education will increase even more rapidly. A detailed analysis along the lines of the above would provide a more specific picture of the engineering job outlook.

We have related these comments to our research program in this field in the Department of Labour, because we believe that the facts which it is producing are an essential foundation for useful discussion about these and other similar issues. ★

Highly-trained engineers and technicians can lead the way to Canada's future economic development, it is thought.

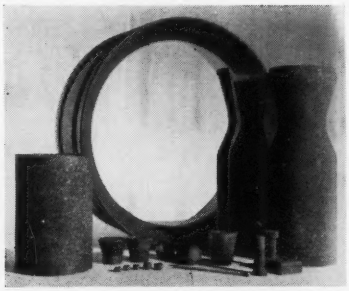
Arthur Joy (left) is DE's west coast editor—his headquarters being in Vancouver, a centre of R and D activity

Michael Fallon (centre) Montreal editor keeps tabs on Quebec and the maritime provinces for news items

Robert Metcalfe (right) heads up DE's Manitoba bureau—completing the coast-to-coast coverage for readers

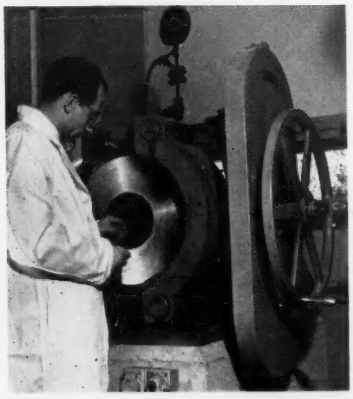
Industrial roundup by DE's editors

Coated graphite



Photograph depicts the primary applications of SiC coated graphite. These materials were initially developed for rocket applications, but are now finding industrial uses. White spots on the coated pieces are light reflections from the crystalline SiC. Abrasion resistance is very high; maximum operating temperature is above 4,000 F in some cases; excellent thermal shock resistance are some of the characteristics of the process, developed by The Norton Company.

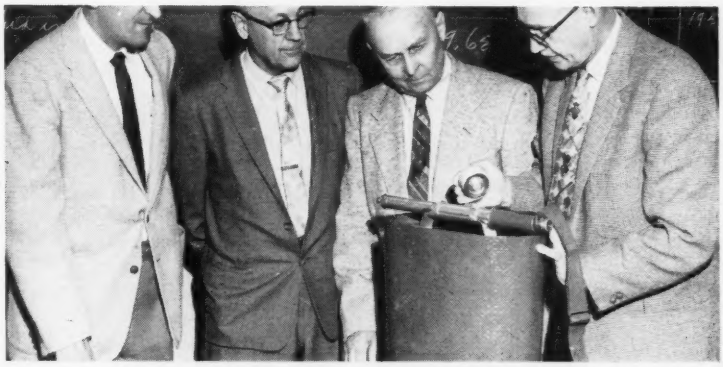
For fume classification



Bichel Gauge developed by Canadian Industries Ltd. is device used in the fume classification of explosives. The product gases are retained within gauge on detonation of charge, then withdrawn and analyzed.

Fibre glass pump developed for Manitoba foresters

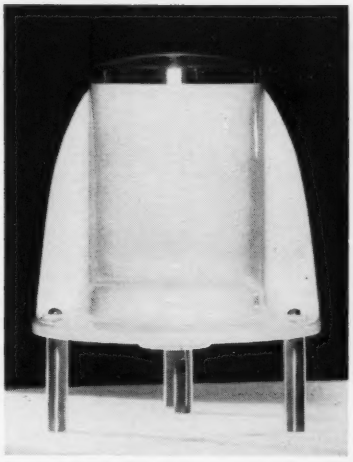
Manitoba foresters will fight fires this summer with a new type of fibre glass back-pack pump developed by provincial forestry officials and manufactured in Manitoba. Pump weighs eight pounds and carries 4½ gal. of water. The pump will not rust and bright red color is incorporated in material.



Magnesium alloys wed

Stepladders by Aerometal Products and Design Ltd. have been developed by using two magnesium alloys of slightly differing strength. They are alloys AZ21X and AZ31X; have wide range of use.

Agitator drive



Agitator drive designed for farm milk tanks has been produced by Tormag Transmission Ltd. Unit is sealed, employs shaded pole motor, two-stage reduction box with steel pinions and non-metallic spur gears.

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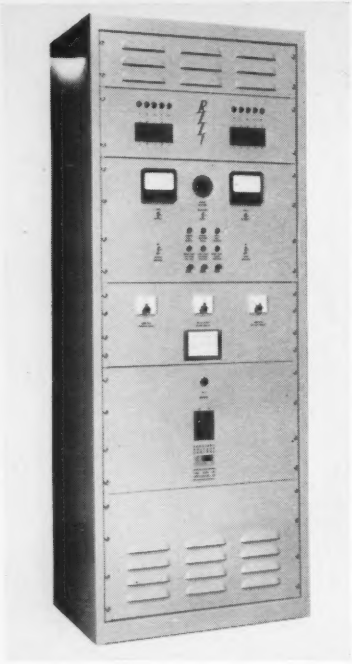
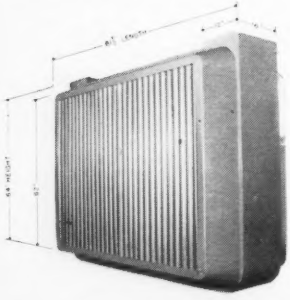
No-outage power supply



New no-outage power supply and amplifier equipment has been developed by Research Industries Ltd. Of original design, the line was made for a peculiar condition existing in B. C. where mountainous terrain makes it uneconomical to build telephone lines. As a result there is an increasing trend toward use of microwave and radio carrier systems. Chargers are made in current ranges 25-300 amperes.

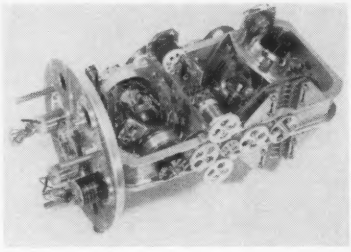
Storing energy



Thermapac provides a gentle and continuous supply of warm, humidified air from a source of "stored" electrical energy. Briefly, electrical power is purchased during off-peak hours and fed to heating elements embedded in a storage pile of specially formulated material which is capable of retaining the heat energy for later use. Heat stored up during the night is released, around the clock, as required. The space-heating equipment was developed by Canadian Curtiss-Wright Ltd.

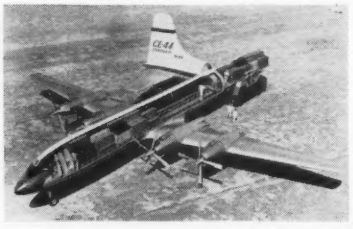
Stable platform

VG/DG Platform is a low-cost stable platform combining the functions of the vertical gyro, the directional gyro and the roll (or pitch) Gimbal error corrector—and achieves substantially improved performance in all functions. The platform mechanism is shown in photo. The design avoids the complications associated with inertial-type platforms, is made by Sperry Gyroscope Co.



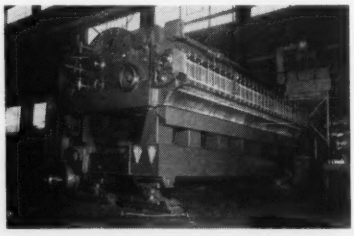
Versatile aircraft

Canadair CL-44. This craft is said to have unrivalled operational flexibility. It has the lowest direct operating costs of any aircraft now being offered to the air carriers of the world. Craft can be used as a freighter, cargo carrier or convertible cargo/passenger carrier. Observe the fold-back tail and rear entrance door. Cargo rails start just ahead of this.

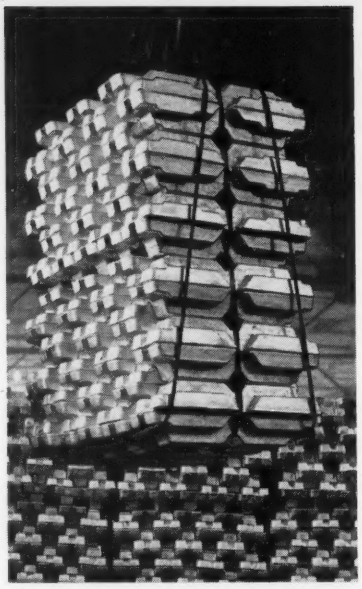


Pressure head box

This is one of many examples of research and development projects of Dominion Engineering Co. It is a pressure head box for paper machines—and is a wholly Canadian development. We understand that this company just completed an expansion program in their hydraulic turbine laboratory, and that it is said to be one of the foremost installations of its kind in the world.

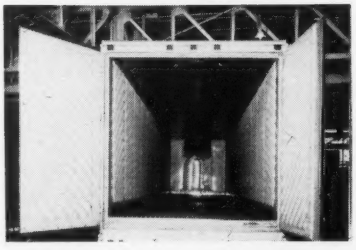


New look in ingots



New look in ingots is a result of an R and D program by Aluminum Company of Canada. When strapped together ingots are locked together in three ways—vertically, laterally and lengthwise. But when unstrapped, individual ingots can be lifted out with ease. Bundles of new ingots also stand up better to shocks in transit: tests proved they will resist up to three times normal humping speed. Note wasp waist on ingots.

Plastic for trailers



Nearly 1,000 lb. of plastic lining and insulation went into the construction of this refrigerated van trailer. It is thought to be the first to use plastic linings as a design material. Interior is an "ideal" way of storage of edible products during haulage: can be washed down, steamed, and is impervious to moisture and bacteria. Ribbed, white plastic panels are designed to provide for the continuous circulation of air, even with a full load. Insulated doors are prefabricated and precision-fitted to the tapered door openings to provide a tight seal. The walls and doors contain 4 in. of plastic-type insulation. Fruehauf Trailer Co. of Canada are manufacturers. ★

What design engineers say about R & D

THE QUESTION: "Most large companies have a research and development program, but to survive many smaller companies should be engaged in strong R and D work. How do you feel about this?"

"I think every industrial firm should engage in Research and Development as much as it can, and regardless of size, must do some development of a practical nature.

But in a medium-sized firm, the amount of money needed to go into advanced research is so great that it is best to leave this work to the big firms with specialized facilities."

—H. H. Roeder, Monarch Machinery Co., Winnipeg.

"It's not feasible for a small industrial firm to engage in Research and Development work because the cost has to be borne by too few products. It's better to get half a dozen good designs from outside — and created by big firms.

These designs can be adapted in part to the small company's needs, without spending the large sums needed for original work. A small or medium-sized firm is handicapped by lack of equipment, facilities and capital, so that it's best to leave this field to the big industries."

—G. W. Newman, Silver Line Manufacturing Co., Winnipeg.

"In answer to your question, I am strongly prejudiced in this matter. I feel it is very true that a company, no matter how small, should have a strong R and D program. Where the company feels that it cannot support an R and D department out of its earnings, it should call in outside consultants to do the work.

The need for research is borne out by the fact that most technical products on the market today were not even designed five years ago. A firm must continually be finding new products if it is to survive.

The proportion of earnings set aside for R and D would depend to a great extent on the need to change products. Some manufacturers, in a competitive market need to change models every year — others may go longer. Nevertheless, the development work is needed by all."

—D. J. Rosenberg, Vector Labs Inc., Montreal.

"Yes, I do feel very strongly that small companies should have an R and D program. Although Canada Fans is a medium firm in comparison to some, we have an active development program, and put aside some of our earnings to finance development work.

In my opinion, every firm should spend say, five to ten per cent of its actual net earnings on R and D work, and in all probability, the proportion should be higher with a small firm than with a large one, because of the greater necessity of forging ahead that a small firm has."

—Leo M. Stirling, Canada Fans Ltd., Clarage.

"Because of the R and D practised by the larger companies in Canada, it becomes an absolute necessity for smaller manufacturing companies to carry on a system of supplementary R and D work.

New materials and techniques are made available daily, and if they are to be used to full advantage, new applications must be explored exhaustively by the smaller companies. New materials have to be understood in order to be properly used, and understanding can only come through an intensive R and D program aimed at a specific end use of each material in question. Continued active R and D is the only positive method of preventing obsolescence from being built into any company's products."

—D. Balint, International Tools Ltd., Windsor.

Rosenberg

Stirling

Newman

Balint

Roeder

The national press comments on R & D

Canadians were urged yesterday to step up their research program to stay abreast in this space age.

Dr. W. E. van Steenburgh, director general of Scientific Services, Department of Mines, Ottawa, said "the time has passed when we can afford to take an indifferent or leisurely attitude toward basic research."

When this attitude mounts to a point where "we are being hounded to get going in this research, then I and all those who share my views on the subject will know that we are 'on course' and that all is well."

Dr. van Steenburgh was speaking to the joint annual meetings of the Prospectors and Developers Association, Geological Association of Canada and the Mineralogical Association of Canada.

"By and large, our total research effort is still several notches below the desired level. Today, for instance, industry in Canada is spending, proportionately, only one-quarter as much for research and development as are industrial firms in the U. S."

(Toronto Globe and Mail, March 4, 1959)

"Canada not even in the race"

That was appalling testimony which the House of Commons Committee on Mines, Forests and Waters heard last week from the top officials of the Mines and Technical Surveys Department.

Mr. John Convey, director of the Department's mines branch, said that in the field of mineralogy and technological research, Canada was one of the world's most backward nations — "not lagging behind, not even in the race." Mining research was totally non-existent in Canada. As a result, Canadian mines were spending Canadian money to have their research done in United States laboratories.

(Globe and Mail editorial, April 20, 1959)

Expert urges more research

The B. C. forest industry was put through the mill Tuesday for not doing enough research.

Research experts at the first B. C. Industrial and Trade Conference at the University of B. C. said the industry is losing business because it hasn't found enough new uses for wood products.

"Sometimes I think the industry is rather like the trees it uses. It gets bigger but it doesn't seem to get any different," said R. H. Wright, head of the chemistry division of the B. C. Research Council.

J. A. F. Gardner of the Forests Products laboratory at UBC, said: "Unfortunately the sawmill industry, like some other old established primary industries, does not have the tradition of research and there are still large lumbering firms and organizations without research departments."

(The Vancouver Sun, May 14, 1959)

UK opens purse strings

London—Britain's Department of Scientific and Industrial Research says it is prepared to underwrite industrial projects for the next five years, "whatever the scale," as long as such projects benefit the nation.

The Dept's research council reported that too many valuable ideas in both small and large companies were going to waste because of lack of finances. The Dept. expects to spend $171 million during 1959-64 as compared to $101 million in the previous five years.

(Product Engineering, May 18, 1959)

Mr. Diefenbaker takes up cudgels

In choosing to speak to the graduating cadets of the Royal Military College in Kingston about Canada's growing role in research and in announcing Canada intends to take part in the exploration of space, the Prime Minister, Mr. Diefenbaker, chose his subject well. There is lively interest in research of all kinds in Kingston and some important aspects of it are being undertaken by the faculty members of the College itself.

Fundamental research into the properties of liquid helium and the superconductivity of various materials at extremely low temperatures, for example, are two of the projects which have been in hand for some years. And thus Mr. Diefenbaker's remark that "it is not always recognized that we have in Canada the scientific knowledge, the facilities and the experience to participate in the exploration of space" was accordingly well received.

(Editorial in Peterborough Examiner, May 20, 1959)

$100,000 for research division

Nerve centre of Evans Coleman and Evans Ltd. is a new $100,000 research and development division.

The research division, the second largest of its kind in Canada, was opened Tuesday at the company's plant on West Seventy-seventh in Marpole. A highly trained staff of technicians will make rigid and regular tests on all products manufactured at the plant.

"This will be the nerve centre of all our operations," said vice-president R. M. Hungerford. "We are all out for the highest quality control. Our customers will benefit tremendously."

Studies by the new research division have resulted in the company introducing glazed structural concrete blocks here.

(Vancouver Sun, May 28, 1959)

B. C. man gets world attention

Vancouver (Special)—A possible Nobel Prize is the lure which has set a west coast industrial - philanthropist chasing $500,000 to give a young University of British Columbia researcher.

The scientist, Dr. Har Gobind Khorana, 39, almost unknown until a month ago, is the centre of world-wide scientific interest for his feat of synthetically producing an important chemical of life.

Said Dr. Gordon Shrum, chairman of the B. C. Research Council: "Never in the history of the university have we had such a distinguished scientist."

Lumber tycoon Walter Koerner is trying to raise funds to allow Dr. Khorana and his seven UBC colleagues on the project to continue and expand their work in the field.

(Toronto Telegram, June 2, 1959)

Chance for the universities

Canadian universities are to be given an opportunity to conduct experiments in space research.

The National Research Council has announced that a space research program to be under direction of an Associate Committee on Space Research formed jointly by NRC and the Defence Research Board.

The committee, set up at a meeting of NRC today at Saskatoon, will include 20 representatives from government departments and agencies and Canadian universities.

(Toronto Globe and Mail, June 5, 1959)

Keeping informed

New booklets and technical data for you to read

Nickel Tubing — The chemical composition, physical constants and mechanical properties of four types of tubing, are listed in this interesting folder, published by Superior Tube Company.

Coated valves — an eight-page, photo-illustrated bulletin describing Rockwell-Nordstrom special coated lubricated plug valves. Available from Peacock Brothers Limited.

Lubrication — just off the press is a manual on the lubrication of roller and silent chain drives. Covers principles of lubrication, maintenance and oil selection. Sun Oil Company Limited.

Motor controls — Arrow-Hart & Hegeman have published a condensed motor controls catalogue, arranged for fast, easy reference. Illustrated throughout with wiring and dimensional diagrams.

Industrial ovens — standard truck-type ovens heated with gas, or oil, either direct or indirect fired, and electric or steam heat are described in a four-page bulletin from Eclipse Fuel Engineering Company of Canada Limited.

Diaphragm control valves — bulletin J-170 gives complete engineering data on OPW-Jordan diaphragm control valves. Used wherever accurate regulation is required.

Instability of hydraulic jack — University of Toronto report UTIA 55, by E. Kosko, discusses the compressive instability of a hydraulic jack.

Appliances — a complete line of appliances manufactured in Canada are detailed in catalogue 90 of Canadian Armature Works Inc. Request on company letterhead.

Lighting handbook — a special handbook is being offered by Canadian Westinghouse. The handbook is designed to assist engineers, architects, contractors, and students. The price is $3.00.

Grouting — describing successful grouting techniques, this bulletin gives recommended mixes and estimating tables. The Master Builders Company.

Insulation — write to Hysol (Canada) Ltd. for a list of technical literature available on epoxy systems and applications in the electronic and electrical power fields.

Seals — a fact book for selecting and installing O-ring and special ring seals marketed by Minnesota Rubber Company. ★

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Briefs

We note with interest . . .

that there's no excuse now for not keeping in touch with your friends and relatives. Twenty "snorkel" mail-boxes have been installed in cities across Canada by the Post Office — others are on the way. (You can drive up to mail box, pop in your epistle without leaving your car) . . . **microbes are being given** the microscope treatment by the Ontario Research Foundation: useful application for the shuddery things includes the production of feedyeast from cheese whey and (a dash more soda Henry) the production of alcohol from molasses and from waste sulphite liquor using a yeast to ferment the sugars . . . **our Montreal editor** writes to tell us about a recent meeting of an SPI chapter when the problems of the mold maker in the designing of molds, estimating and legal responsibilities were discussed. There's a shortage of mold-maker apprentices — so the SPI is producing a movie to help attract them into the fold . . . **new commercial** paint spraying equipment introduced at the U.S. Patent Office's recent mechanical exhibit in Washington is said to outdate other methods of spray painting — can be used in high humidity . . . **swinging to colder news,** Soviet explorers trekking across the Antarctic will do so in a luxury-crammed 35-ton tractor. It's hermetically sealed, air conditioned, has showers, armchairs, galley — to say nothing of a battery of technical equipment, all of which can be operated from inside the vehicle . . . **wot d'ya think chaps?** Cambridge University is setting up a faculty of criminology. We'd just stuffed our last no-iron shirt into a grip, when we realized the course isn't intended to turn every jemmy-jockey into a rakish-Raffles. It's to help stamp out crime . . . **design engineers** in a U. S. research centre claim to have well-nigh licked "shielding" in the miniature bearings industry. Their idea reduces by 70% the size of dirt particles which can get into bearings . . . **a Toronto woman** took a hair-removing course at a local beauty parlor, and now has to shave twice a day she said in court (our bald customers please note) . . . **scientists have reported** that a crude "death-ray" derived from certain ultra-high frequency radio waves, has killed 10 monkeys . . . **an aircraft tape** recorder that can take up to 360 intricate readings in any five-second period, and can be ejected from a crashing plane could simplify the investigation of air crashes . . . **shortly before** a ship was due in

(Continued on page 83)

Briefs *(Continued from page 82)*

Los Angeles, the master had his crew remove cargo lashings to save unloading time at port. Longshoremen refused to unload cargo unless lashings were put back. When captain complied, longshoremen simply cut rope with knives so that it couldn't be used again. This rates the Most Futile Act of the Month award . . . **while on a** steak-safari at the recent Design Engineering show in Philadelphia, a New Englander said, "Wouldn't you like to have as much fun on a convention as your wife thinks you have?" This unsettled us so much we ordered lobster . . . **Walt Disney has built** a mile-long monorail system. Trains have rubber tires — run on pylon-supported concrete runways — and are operated electrically . . . **two tire items** of interest: a U. K. firm is dickering with "atomic" tires (exposed to radiations from isotopes, tires are said to be tougher and age more slowly). Harold Cole, a dispatcher for a Toronto firm, has invented a sidewall protector for tires. Tire guard is welded on wheel rim, is 2½ in. wide and made of ¼-in. steel . . . **the Rad** has been chosen as the national standard radiation dose unit, we hear. If this will tell us how much quicker we'll be able to withstand the ravages of hydrogen-bomb tests, strontium-flavored milk, the deadly weed, beatnicks, weekend driving and the top 600 hit tunes — we should (we guess) be very grateful . . . **British-American** Oil Co's projected $1½ million warehouse distribution centre and dock at Port Moody, B.C., will be located so that shipments can be made directly by rail, truck and sea . . . **can an off-shore** drilling platform get seasick? If so, pity the poor rig that was made in the U. S. and had to make the 7,000-mile voyage to Sicily where it will be stationed . . . **one answer** to that old question "What next?" is paper tents and disposable clothes (both are being tested now) . . . **vive la France** for interest la femme. Some old maids over 60 with cars more than 10 years old get tax exemptions from the de Gaulle Government. It's a new formula to catch up with taxpayers who live high but pay low. The young chicks are going to pay up for their chromium-plated memories, while the old hens tootle along mulling over theirs . . . **who said Scotsmen** are not romantic? The chairman of the Marriage Guidance Council in Edinburgh wants to start night classes in the art of love for youngsters between the ages of 16 and 20. The course will give a diploma to successful candidates . . . **when Jules Verne** conceived of a giant gun barrel 900 ft long with 400,000 lb of guncotton in the breech to launch a moon-ship, he wasn't too far off the truth. A group of scientists is planning to launch a space-arrow in this fashion . . . **we hear that** a quarter of a million dollar charcoal plant is to be built northwest of Edmonton . . . **Brief Talepiece:** There's nothing like organization. We like the story about the NCO admitted to hospital for possible surgery. The company supply sergeant sent him a get-well card. Inside, the message read: "If they take anything out, make 'em sign for it." ★

New Committee

Doug Kaill, editor of DE was elected to the position of secretary in the Standards Engineers Society, Hamilton/Toronto Section for the season 1959-60, at a meeting held in Hamilton on May 28. Other officers of the society are J. G. Wells (CGE), chairman; C. L. Moon (AECL), vice-chairman; S. F. Coolsma (Westinghouse), treasurer; R. F. Whatmough (CSA Laboratories), executive officer.

The society has been active in Canada since 1955, fostering the cause of standardization in engineering design and development. The group does not take any direct action in the establishment of specific standards. ★

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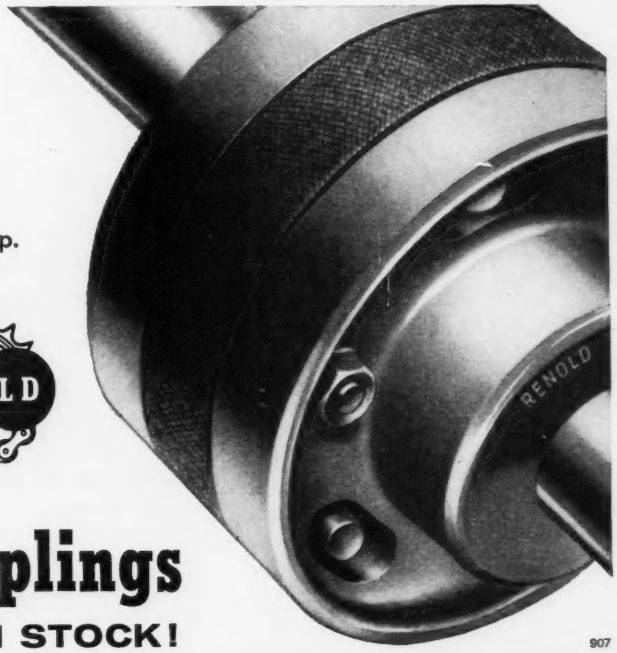

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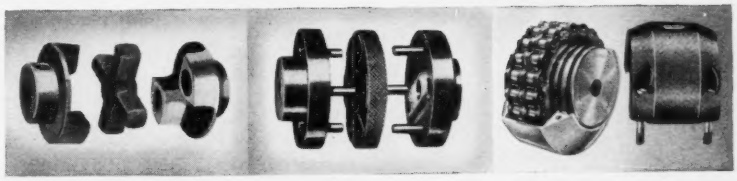

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People in the news

A Guelph, Ont., chemist, **Dr. Richard H. Manske,** is the 1959 winner of the Chemical Institute of Canada medal. Dr. Manske, who is director of research for Dominion Rubber Co. Ltd., in Guelph, is a graduate of Queen's and Manchester Universities. He is a member of the Royal Society of Canada; the American Chemical Society; The Chemical Society, London; and the C.I.C.

Professor David M. Myers, head of the department of electrical engineering at the University of Sydney in Sydney, Australia, has been appointed dean of the faculty of applied science at the University of British Columbia.

Prof. Myers has been P. N. Russell professor of electrical engineering at the University of Sydney since 1949 and was elected dean of the faculty of engineering there in 1955.

* * *

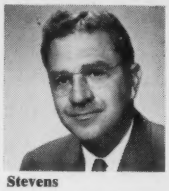
The appointment of **James W. Torrant** as industrial sales manager of Morse Chain Company, a Borg-Warner Industry, Ithaca, New York, has been announced.

J. H. Harrison has been appointed sales manager of the Industrial Division of

Harrison

Jones

Dominion Engineering Co. and **H. J. Jones,** chief engineer of the rolling mill



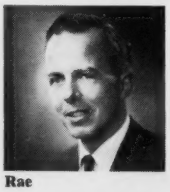
Stevens

Dunton

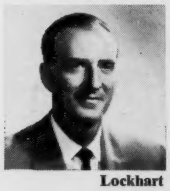
department. **R. W. Stevens** has become sales manager and **Mr. R. W. Dunton,** chief engineer of the press, mining and rubber departments.

* * *

Three new appointments have been announced by Alpha Manufacturing Company Ltd., Winnipeg. **A. K. Piercy,** P.Eng., becomes Application Engineer and **G. D. McKenzie,** P.Eng., becomes Research and Development Engineer. All three men are members of the Engineering Institute of Canada. They will locate at Alpha's Head Office in Winnipeg.



Rae



Lockhart

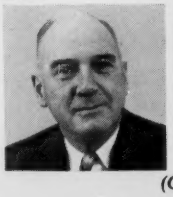
Mr. Arthur C. Rae is named vp marketing of Atlas Steels Ltd. and general manager of the Atlas International Division.

Mr. F. J. Lockhart, vp, Canadian sales, becomes vp-sales, North American Division. * * *

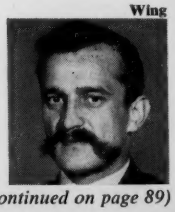
Mr. U. M. Evans was recently elected a Director of Anaconda American Brass Ltd. Evans, who joined the Rod Mill Staff in 1918, has been Works Manager since 1942. * * *

Maurice Keith Wing of C. A. V. Limited, has taken up an appointment as project engineer for the company in Canada. For the past five years he has served with C. A. V. as projects engineer on the application of fuel injection equipment to diesel engines in Britain.

Evans



Wing



(Continued on page 89)

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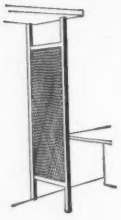

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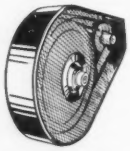

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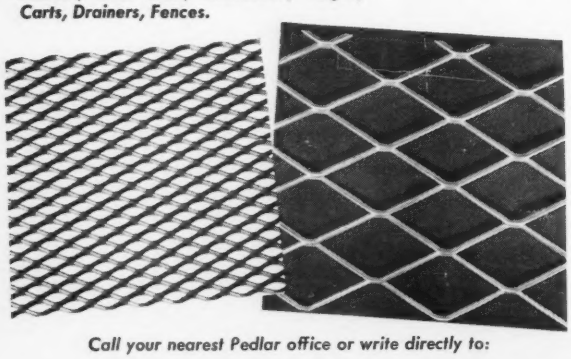

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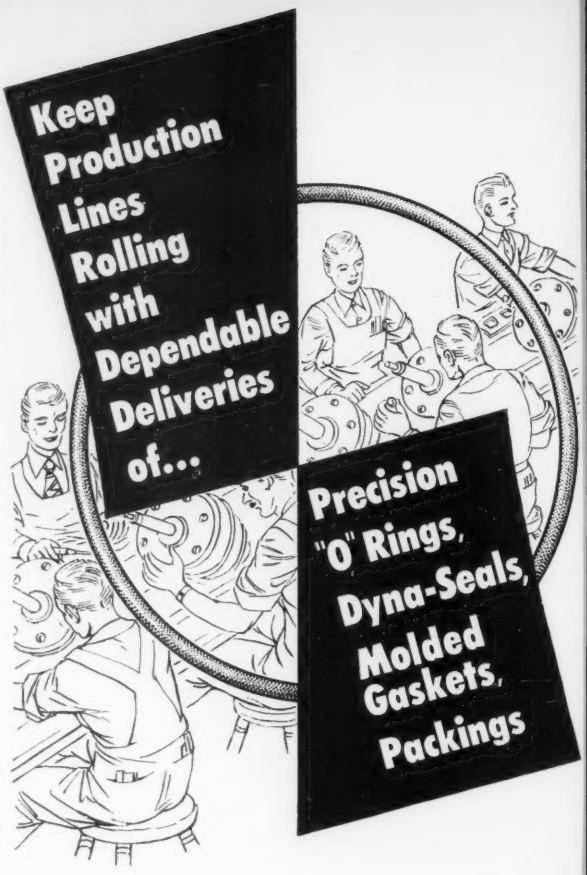

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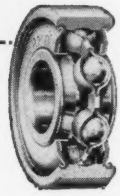
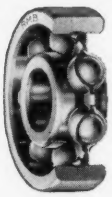
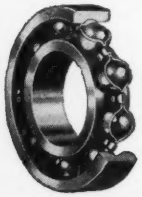


*** Radial FILMOSEAL type.**
Big bearing sealed performance in miniature sizes from 0.0550" Bore — 0.1875" OD. An RMB "first."

*** Radial Conrad type.**
Another RMB "first." True Conrad retainer design with deep groove ground raceway. Sizes from 0.0550" Bore — 0.1875" OD.





*** Radial Ultra-Light.**
Precision space savers. Combine large bores with relatively small OD's. Sizes from 0.0394" Bore — 0.1181" OD.

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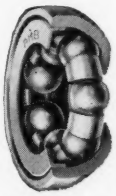

*Many other types including pivot types with inner races, radials without inner races, miniature roller bearings, to name a few.

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People in the News *(continued)*

Mr. Donald D. McNabb has been appointed Vice-President in charge of the Central Division, of Reichhold Chemi-

Bigelow

McNabb

cals Ltd. Mr. **John H. Bigelow** has been appointed Vice-President in charge of Sales. **E. Gordon Arnold** has been elected to the board of directors.

* * *

Kenneth G. Thorne has been appointed chief engineer of Computing Devices of Canada Ltd.

* * *

John H. Barker has been appointed Development Specialist for the Plastics Division of Monsanto Canada Ltd.

* * *

Robert M. Jennings, W. Frank Wanbrough and **Walter G. Ward** have been appointed vice-presidents of Canadian General Electric Company.

* * *

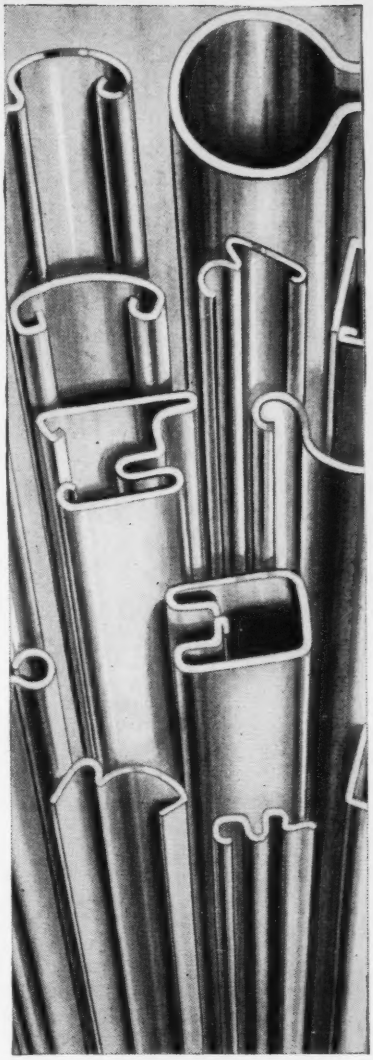
John S. McConkey has been appointed sales manager—component heating devices, industrial products department, Canadian General Electric Company.

* * *

Ronald S. Rose was recently appointed sales manager of Canadian Ice Machine Co. Ltd. Rose is engineering graduate of Duke University, Durham, N.C. ★

Acknowledged with thanks

The editors of Design Engineering wish to thank the many people who made this issue possible. While researching material, we contacted hundreds of individuals in industry, government services, universities, provincial research councils—and of course design engineers. It should be pointed out that we received much information which did not fit in with the definition of R and D, and it was, for this reason, left out of the report. As the cover says, our interest was in R and D in Canada. Every effort was made to give a factual account of the current Research and Development picture in relation to the engineering profession in Canada.



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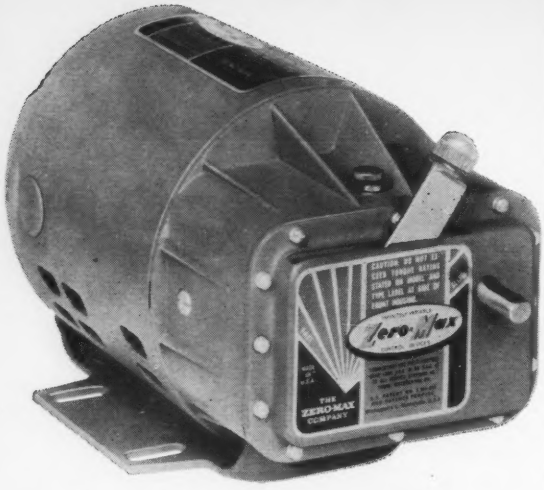

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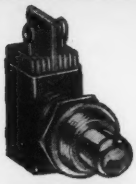

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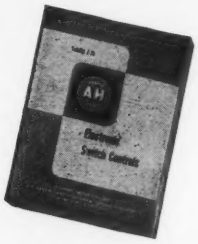

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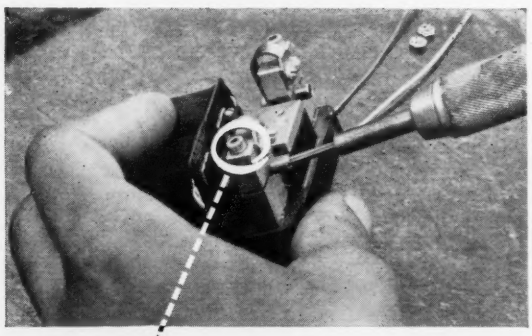

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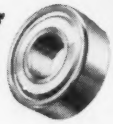
B·M·B mini-bearings



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Bearings are manufactured to American ABEC specifications.

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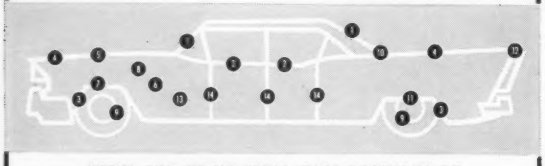

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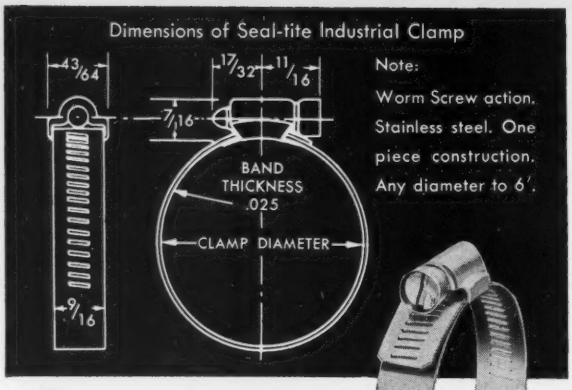

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Advertising Index — July

Key No.		Page No.
101	Airmatic Valve Inc.	7
102	Algoma Steel Corp. Ltd.	11
103	Alloy Metal Sales Ltd.	10
104	Anaconda American Brass Ltd.	29
105	Arrow-Hart & Hegeman (Canada) Ltd.	91
106	Atlas Steels Ltd.	22
107	Bakelite Co. Div. of Union Carbide Canada Ltd.	37
108	B.M.B. (Sales) Ltd.	92
109	Bristol Co. of Canada Ltd., The	91
110	Bruning Co. (Canada) Ltd., Charles	20
111	Canada Illinois Tools Ltd.	17
112	Canada Illinois Tools Ltd.	93
113	Canada Iron Foundries Ltd.	15
114	Canadian Allis-Chalmers Ltd.	28
115	Canadian Chemical Co. Ltd.	31
116	Canadian S.K.F. Co. Ltd.	21
117	Chesterfield Tube Co. Ltd.	IBC
118	Clearprint Paper Co.	25
119	Cresswell Pomeroy Ltd.	89
120	Dominion Fasteners Ltd.	24
121	Dominion Forge Ltd.	38
122	Dominion Magnesium Ltd.	87
123	Dominion Rubber Co. Ltd.	19
124	Dominion Rubber Co. Ltd.	26
125	Donald Ropes & Wire Cloth Ltd.	40
126	Du Pont of Canada Ltd.	42
128	Porter Co. (Canada) Ltd., H. K. Federal Wire & Cable	44
129	Flexonics Corp. of Canada Ltd.	92
130	General Tire & Rubber Co. of Canada Ltd.	92
131	Glidden Co. Ltd., The	16
132	Hamilton Clamp & Stampings Ltd.	92
133	Heim Co.	46
134	Hunter Douglas Ltd.	35
135	International Business Machines Co. Ltd.	IFC
136	International Nickel Co. of Canada Ltd.	14
137	I.R.E. Canadian Convention	82
138	Landis & Gyr. Inc.	89
139	Link-Belt Co. Ltd.	2
140	Marsh Instrument Co.	91
141	Miniature Precision Bearings Inc.	41
142	Parker Rust Proof Co. of Canada Ltd.	8, 9
143	Peacock Bros. Ltd.	13
144	Pedlar People Ltd.	88
145	Polymer Corp. Ltd.	4
146	Potter & Brumfield Canada Ltd.	43
147	Precision Rubber Products (Canada) Ltd.	88
148	Renold Chains Canada Ltd.	83
149	Renold Chains Canada Ltd.	90
150	R & M Bearings Canada Ltd.	84
151	Shawinigan Chemicals Ltd.	12
152	Shawinigan Chemicals Ltd.	93
153	Skinner Electric Valve Div.	32
154	Spaulding Fibre of Canada Ltd.	36
155	Sperry Gyroscope Co. of Canada Ltd.	34
156	Steel Co. of Canada Ltd., The	27
157	Stephens-Adamson Mfg. Co. of Canada Ltd.	30
158	Stevenson & Co. Ltd., Jas. W.	91
159	Stewart-Warner Corp., Alemite Div.	39
160	Strippit Tool & Machine Co.	81
161	Timken Roller Bearing Co.	OBC
162	Torrington Co., The	23
107	Union Carbide Canada Ltd.	33
163	United Shoe Machinery Co.	87
164	Vickers—Sperry of Canada Ltd.	18
165	Victor Mfg. & Gasket Co. of Canada Ltd.	45
166	Wade Co. Ltd., Norman	90
167	Wallace Barnes Co. Ltd., The	33

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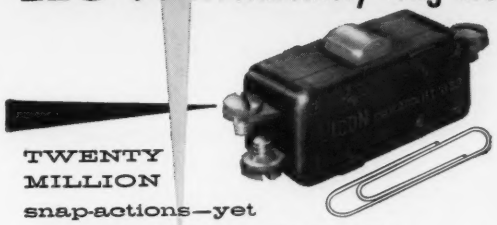

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Editorial

Fight competition with R and D

Research and development is a topic that should be at the core of every industrial operation in Canada. Unfortunately, this is not always so. Far too many firms are content to let their parent company in the U. S., or altenatively, their competitors in Canada, do all the lead work in developing products and designs that will meet the needs of this missile age.

Canadian engineers and designers can, and do, originate some ideas which win national and international acclaim. Witness such outstanding achievements as the Orenda engine, which was the star attraction at the 1959 Design Engineering Show in Philadelphia last month, and heavy-water moderated research reactors which Canadians have pioneered.

This program needs support, and plenty of it. Government has been outstanding in its support. Universities and their often-underpaid teaching staffs have given of their best, although we fail to understand why some of them did not respond to the opportunity to present their story along with the others in this issue. Incidentally, every university in the country which has an engineering faculty was invited to do so.

Some industries have done admirably. More power to them, because it is usually their kind that are heading the parade of sales and profits.

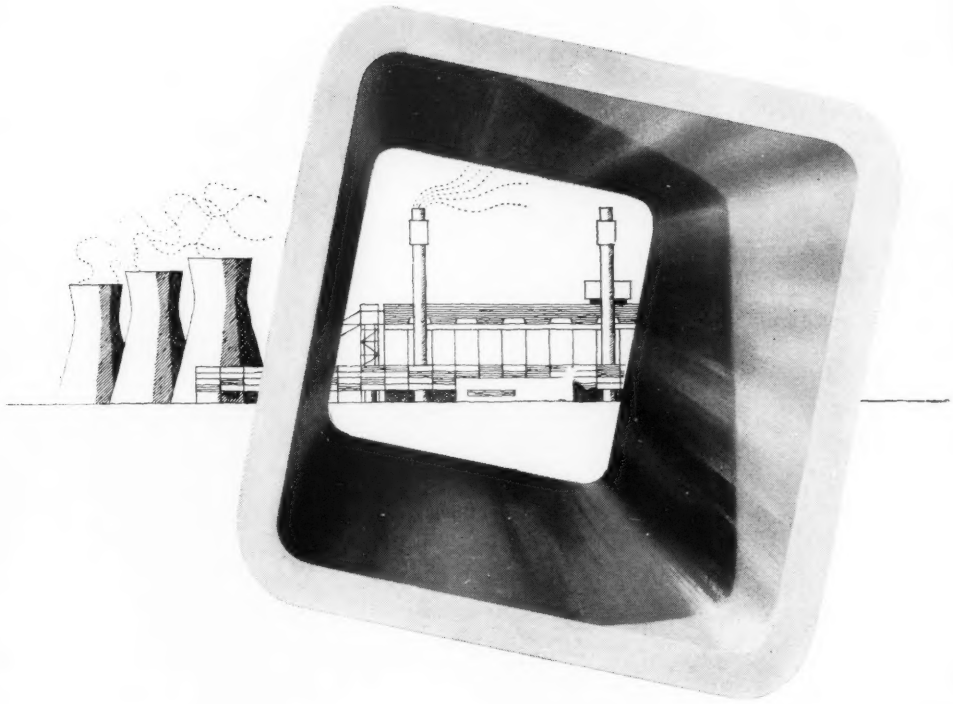
We are reminded at this time of the sales pitch for a brand of filter cigarettes advertised across the border. "It's what's up front that counts. If it hasn't got it there, it hasn't got it anywhere."

In the competitive world of industry, what's up front is R & D. If a firm hasn't got it there, it just hasn't got it.

With this issue, devoted entirely to Research and Development, DE scores another first in publishing history. So far as we can ascertain, no other publication in the engineering field has ever given over its full editorial content to the R & D theme.

Full credit for the material contained in this issue must go to our genial assistant editor, Eric Haworth, who almost singlehandedly, has put together these pages. This was accomplished in the difficult transition period during the changeover of editors. As a result of his efforts, Eric is probably the outstanding authority on the position of R & D in Canada. He also is possibly its strongest advocate.

Doug Kaill



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3 new applications get longer life and minimum maintenance using Dodge pillow blocks with Timken bearings

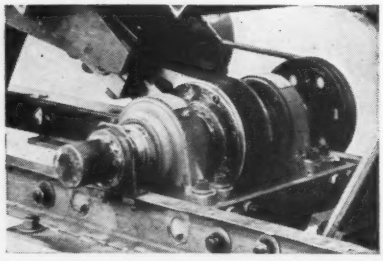
PICTURED below are three applications where Timken bearing equipped Dodge pillow blocks stay on the job with little attention under tough conditions. Their tapered design lets Timken bearings take *both* radial and thrust loads in any combination. And full-line contact between rollers and races provides extra load-carrying capacity. Wear is reduced, maintenance is cut to the minimum.

Cutaway view shows the Dodge All-Steel pillow block with Timken bearing mounting. Of special design, the bearing has a tapered bore with self-aligning spherical outer surface —never needs adjustment.

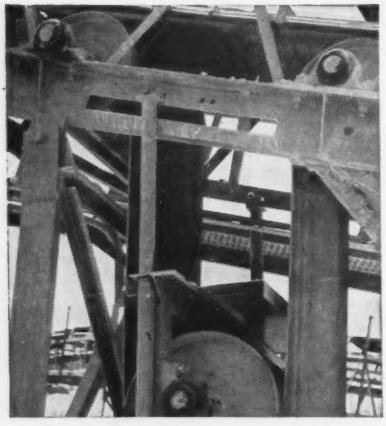
Besides the All-Steel pillow block, other versatile Dodge pillow blocks with Timken tapered roller bearings are: Type "E", Double-Interlock, Type "C" and Special Duty. All are compact in design. Special thrust devices that take up extra space are not needed.

Timken bearings bring Betterness to any machines because Betterness rolls on Timken *tapered* roller bearings. So specify bearings trademarked "TIMKEN" for the machines you buy or build. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

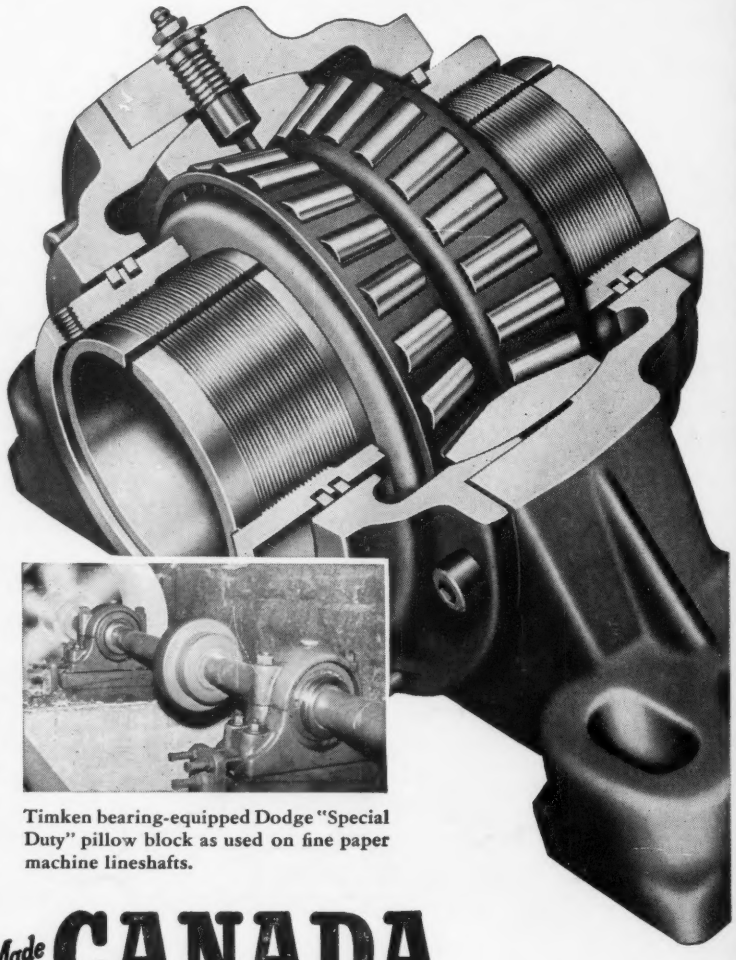
This symbol on a product means its bearings are the best.



Timken bearing-equipped Dodge All-Steel pillow block used in a vibrating conveyor.



Timken bearing-equipped Dodge Type "E" pillow block used in sand and gravel plant.



Timken bearing-equipped Dodge "Special Duty" pillow block as used on fine paper machine lineshafts.

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TAPERED ROLLER BEARINGS

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